UTAH IRON DEPOSITS

Other Than Those of Iron and Washington Counties, Utah

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Circular No. 24

OF THE

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

COLLEGE OF MINES AND MINERAL INDUSTRIES

University of Utah

Salt Lake City, Utah

1943

Reprinted

August, 1952

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UTAH IRON DEPOSITS OTHER THAN THOSE OF IRON AND WASHINGTON COUNTIES, UTAH

by

Arthur L. Crawford 1/
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Iron ore, in form of magnetite and hematite, has long been known to exist in deposits of economic significance within the state of Utah. The iron ores of southern Utah were utilized as early as 1856 when iron ore was reduced in an imperfect furnace at Cedar City. Directly because of these extensive deposits along with large and favorably located occurrences of coking coals, limestones, and dolomites, the Columbia Steel Corporation, western subsidiary of the United States Steel Corporation, has operated a pig iron plant successfully for over 20 years at Ironton, south of Provo, Utah.

Since the Pearl Harbor "stab in the back" by Japan, the United States has geared itself into full-war production of all vital material, among which steel occupies a most prominent position. Again, because of the southern Utah iron deposits, Geneva, northwest of Provo, and Ironton were chosen as the sites of an enormous steel expansion program. At an estimated cost of $150,000,000 a plant is now well under way at Geneva and the Ironton pig-iron plant is being greatly enlarged. Some of the more recent figures give a total estimated yearly capacity of about 1,400,000 tons of pig-iron, a rated capacity of 1,200,000 tons of open hearth ingots, 400,000 tons of plates and 250,000 tons of structural shapes. The total yearly estimated iron ore consumption is 3,200,000 tons. Thus far estimates for southern Utah iron reserves have been placed at 90,000,000 tons of 50 per cent or more iron. This figure will probably be proved low, but at present it is the safest figure that maybe used. Therefore, it is apparent, unless more ore is uncovered in the development of the known deposits, that at the present rate of consumption southern Utah iron reserves will be depleted within approximately 30 years. With this in view, the purpose of this brief is to compile information for public distribution on iron ore occurrances in Utah other than those of Iron and Washington counties. Even though the available information regarding these iron deposits is by no means complete, it is hoped that sufficient data is presented to insure further detailed study on at least the more interesting deposits.

Iron ore in undetermined quantities, but of commercial quality, is known to be present in several regions of Utah other than those previously mentioned. Many of them are not of commercial importance but are included as a matter of record. For convenience they are roughly subdivided into groups and will be discussed as follows:

1/ Geologist and Mineral Technologist, Utah Engineering Experiment Station, University of Utah, Salt Lake City
2/ Geologist, Raw Materials Division, Utah Publicity & Industrial Development Department

1. Uinta Mountains
   a. Rhodes Plateau
   b. Pope Deposit
   c. Woodside Deposit
   d. Birch Creek Deposit

2. Wasatch Range
   a. Big Cottonwood Deposit
   b. Morgan Deposits
   c. Ogden Deposits and Willard Deposits

3. Bear River Range
   a. Mineral Point Deposit

4. Wah Wah Range
   a. Wah Wah Deposits

5. Miscellaneous Deposits
   a. Dragon
   b. Lucin
   c. Marysvale

Uinta Mountains

The Uinta range of mountains, unusual in its east-west axial trend, is located in northeastern Utah. Its eastern boundary extends into Colorado while its western boundary merges into the Wasatch range in the vicinity of Park City, Utah. It is roughly 150 miles in length and averages some 35 miles in width. The formation of the range represents a long period of continuous deposition of similar materials. This is exemplified by the fact that its central core and most of its areal extent are composed of a great thickness of relatively uniform sedimentary quartzites. Its glacial features have been described in detail by Atwood[1/] and its physiography, geology, and topography by Boutwell[2/] and Butler[3/] and others.

Iron ores have been developed to some extent at various localities throughout the range during the early mining development of Utah. The ores consist chiefly of hematite and limonite, although both magnetite and siderite are also present. A characteristic feature of the iron deposits is their extremely low content in phosphorus and sulphur, and on a whole they constitute a fine grade of iron ore.

Among the earliest discoveries were the deposits of the Rhodes Plateau. Although they have been inactive for many years as far as production is concerned, the quality, and nearness to the steel center, should provide the necessary incentive to further explore these deposits and prove their economic worth. The original operations were confined to the hematite variety of iron ore which is reported to occur in large but undetermined quantities. Within recent years interested parties have called attention to iron-carbonate (siderite) as another iron ore that has been proved to exist in the same area. Such men as A. L. Crawford[4/] and Dr. J. R. Mahoney[5/] of the University of Utah, Salt Lake City, Utah, have reported this mineral as being present in this vicinity where it occurs as nodules in shale and as replacements of

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1/ Glaciation in the Uinta and Wasatch Mountains; U.S. Geol. Surv. Prof. Paper 61, 1909.
2/ Iron Ores of the Uinta Mountains, Utah. U.S. Geol. Surv. Bull. 22, pp. 221-228, 1904.
3/ The Ore Deposits of Utah; U.S. Geol. Surv. Prof. Paper 11, pp. 559-561, 1920.
4/ and 5/ Personal Communication

Paleozoic limestones. These men are both of the opinion that the area deserves more detailed attention by the geologist.

Rhodes Plateau

The following description of the Rhodes Plateau is given by Boutwell:1/

"These iron deposits are situated in Wasatch county, Utah, in the southwestern portion of the Uinta range about 10 miles south of its main divide on the main divide between Provo and Duchesne drainages at the head of Soapstone Creek. It is reported that the continuation of the same route leading by other deposits to the south may also be taken from Duchesne on the east.

History and Development

"The iron was probably discovered and first used by the Indians, and a reliable authority informs the writer that the red ore of these iron deposits was used by them for paint.

"About 25 years ago the most promising deposits were located by a party from Heber led by a man named Cummings. It is believed that they did the first actual development work on the property and hauled a few loads of ore to the smelters in Salt Lake Valley. Two years later, when Mr. (T.W.) Potts first visited the locality, he noted 'two small cuts about 200 feet apart' which 'looked as though 10 or 12 tons of ore might have been taken out.' In 1879, upon the completion of a smelter at Park City, he mined 200 tons of this ore and delivered it at the smelter for flux. The following year he delivered 300 tons, and further shipments were then stopped by the closing of the smelter. It is thus known that shipments were made amounting to 500 tons. It is believed that the total is a little higher. In 1882 or 1883 the ground was surveyed for patent, and seven claims, each 600 by 1,500 feet, were eventually patented to E. P. Ferry. Some further prospecting has since been done in the vicinity, and as a result a few more claims may have been staked. In the fall of 1902 other croppings were prospected, additional claims were laid out, and some assessment work was sone.

Character of Ore

"The ore is a red hematite of two varieties, the red orcherous and the gray massive semispecular. It varies in purity from samples of higher grade, which are solid pure iron, to samples which are breccias made up of angular fragments of ore, to others which include barren country rock predominating encloses patches of lean ore. The following analysis is of a selected sample of the high-grade, massive semispecular variety:

1/ Iron Ores of the Uinta Mountains, Utah: U. S. Geol. Surv. Bull. 225, pp. 221-228, 1904.

Analysis of red iron ore
(hematite)
(Analyst, E. T. Allen)

Fe_2O_3	79.34
Al_2O_3	.15
TiO_2	None
CaO	None
MgO	Trace
SiO_2	18.55
S	None
P_2O_5	Trace
Au	None

"The above analysis reveals not only a high content of iron and suitable amount of silica but also a most desirable absence of the deleterious elements, titanium and sulphur and only a trace of phosphorus. In short, it indicates a high-grade workable iron ore. The records of assays of the lots shipped to the Park City smelter in the early eighties were entirely destroyed by a great fire in 1898. It is reported from memory, however, by T. W. Stringer, custom assayer at Park City, Utah, that the shipments averaged about 50 per cent iron and 5 to 20 per cent silica.

Occurrence of Ore

"The features shown by the croppings, together with those few comparatively restricted cuts, did not afford complete evidence as to the true nature of the occurrence of the iron. The country is a gray limestone. In the saddle in which the ore has been worked, the general southerly dip of the strata (S. 50 degrees W. 10 degrees) passes into a gentle northerly dip, thus forming a shallow trough. Further, certain disagreements of dips and zones of breccia suggest that the deformation at this point includes not only local folding but also fracturing and perhaps faulting. The age of the limestone member in which the ore is found is proved by its fossil contents to be lower Carboniferous.

"The croppings of the iron ore and thus the pits which have been opened in them, appear to lie in certain fairly distinct easterly-westerly lines or zones. This fact, in connection with the presence of breccia in the upper pit and the exposure of a marked breccia zone in the lower pit, suggests that the ore occurs along lines and zones of fracture. Further, the fact that the limestones, both in the breccias and in the country rock traversed by the breccias, has given place to iron ore, and the apparent but indistinct retention of bedded structure by the ore leads to the belief that the iron ore is a replacement of limestone in and adjacent to east-west fracture and breccia zones.

Commercial Aspects

"The above analysis indicates that this ore is of excellent quality. So little development work has been done that there is meager basis for estimating its quantity. * * * At present the nearest railroad point is Park City, about 35 miles west.

Standing timber is plentiful, and a small creek flows across the property."

Iron Deposits North of Vernal

A number of iron occurrences are known to exist in the eastern portion of the Uinta Range. The available information on them is vague at best, chiefly because the small amount of development work could not justify more detailed study. Three of the known deposits are located northerly from Vernal and it is entirely possible that other occurrences of iron ore not mentioned in this report exist in the area. Isaac Newton of Vernal showed the writers some fine appearing limonite that he stated occurs some 9 miles or so north of Vernal, but in as much as the deposit was not visited, it shall be omitted from further discussion.

According to George Pope, who controls the Pope Iron Deposits, the iron is exposed in a vein that is traceable for several miles. At the property it is 35 feet in thickness. However, only 12 feet is of commercial grade. The vein pinches and swells but is generally over 5 feet wherever exposed in surface outcrops. In the early days when the Dyer Copper Mine (which is located adjacent to the iron deposits controlled by Pope) was producing copper from its "bonanza" ore body, a smelter was erected nearby to treat the copper ore. During its two years of operation, iron ore from the Dyer Mine was used as a flux. Butler[8/] in his description of the iron ores of this region makes the following statements on the Pope and Woodside deposits:

"The Pope Iron Mine is near the summit of the Uinta Range in Uinta County, about 25 miles northwest of Vernal, near the Dyer Copper Mine. The deposits have been prospected to some extent, and a little ore was shipped to the Dyer Copper Smelter for flux.

"The ore is said to be low in sulphur and phosphorus and to be of good quality for making iron, but the deposits have not been sufficiently prospected to demonstrate their size or the grade of the ore as it would average in mining. The abundant float below the outcrop suggests a rather large body. It is probable, however, that iron constitutes a much higher proportion of the float than it does of the rock from which the float was derived; for the ore is much heavier than the limestone and tends to concentrate as a placer deposit.

"The ore replaces limestone, probably of Mississippian age. Even in high-grade ore, the structure of the replaced beds can be detected, and there is every graduation from high-grade ore through partly replaced to little-altered limestone. Replacement has evidently occurred in certain beds, but whether or not the deposits are closely associated with fissures was not positively determined. The determination of the commercial importance of the deposits must await more extensive development, for which there will be little encouragement till the transportation facilities are improved.

"Woodside iron prospect was opened in 1913 in a branch of Ashley Canyon about 20 miles northwest of Vernal, Uintah County,

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8/ The Ore Deposits of Utah: U.S. Geol. Surv. Prof. Paper 111, p. 603, 1920.

and about 2 miles west of the old 'Red Pine Site.' The few feet of development work does not show the extent or the structural relations of the deposit, but the small amount of float below the outcrop does not indicate a large body of ore. The development exposes some rich hematite, which according to Grant Carpenter is low in phosphorus and sulphur, like other deposits of the range. ***The iron deposits, like others in the range, replace limestone. There is evidence of fissuring or faulting of the rocks associated with the deposit, and the replacement probably took place adjacent to a fissure. Other deposits have been reported from the range, but no reliable description of them is available. Careful prospecting may disclose additional deposits."

A highly siliceous limonite iron-ore is reportedly[1/] abundant in Daggett County, Utah. The main deposit is located roughly two miles south of Edward's ranch, on the east slope of Birch Creek in Sec. 3, T. 2 N., R. 17 E., S. L. M., and is approximately 16 miles southwest from Manila. It occurs in Palezoic limestone and outcrops some 700 feet above the creek bed. No information is available regarding the size of the deposit other than it has been prospected to a vertical depth of 30 or more feet. The original development work was done by local ranchers in search of precious metals, but evidently none were found. A sample submitted to the writer assayed 44.5 per cent iron and 31.1 per cent insoluble. From the above analysis, assuming that the sample tested represents an average grade of ore, there is little hope that this occurrence of iron ore will be of any future value.

Wasatch Range

Throughout the Wasatch Range, iron ore, in the form of magnetite, hematite and limonite, is continously being encountered by the prospector in his quest for valuable minerals. Its most common form is limonite, the hydrated exidation product of the ores or minerals containing iron. Limonite is usually associated with the metalliferous deposits of the range, but thus far has not been found in sufficient quantities to be considered of economic importance as an iron ore. Both magnetite and hematite occur in deposits that are high enough in their iron content (and in some cases associated with other valuable metals) to be of interest as deposits of at least probable potential value.

Magnetite and hematite (chiefly specularite) are present in the contact zones of Big Cottonwood and Little Cottonwood Canyons. Most of these deposits are in limestone, intimately associated with the intrusive rocks containing the commonly called "contact minerals." They exist along the borders of the Alta-Clayton Peak stock and also around the periphery of other intrusives where they abut against limestone. At some localities these contact zones contain an abundance of iron, notable of which is the ore deposit of the Mountain Lake Mine, now controlled by the Great Western Mining Company.

Hematite and magnetite occur in the Paleozoic and Pre-Cambrian rocks of the Wasatch Range east of Ogden and Willard, Utah. Large

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1/ Personal communications with F. J. Briggs, Salt Lake City, Utah

deposits of iron ore are also said to be present in the vicinity of Morgan. The deposits located near Ogden were discovered many years ago, and a furnace was built in 1876 to treat the iron ore, but it closed down soon after its initial operation.

The Mountain Lake Mine

The Mountain Lake Mine was visited by A. M. Buranek in the fall of 1939. It is now controlled by the Great Western Mining Company. J. W. Knight of Provo, Utah, is president of the corporation. No production is credited from the property during recent years. In fact, the only ore shipped was during the early "boom days" of the Cottonwood-American Fork region.

The mine is located some two hundred yards above Dog Lake, at the head of Big Cottonwood Canyon. Brighton, now recognized as one of the leading winter sport centers of the Wasatch, is situated approximately one mile by road to the north, at an elevation considerably lower than the mine. The property is readily accessible over a hard surfaced road that connects Salt Lake Valley with Brighton, and from there a dirt road in very poor condition leads to the holdings.

The ore body made at the contact of the Alta-Clayton Peak stock with Paleozoic limestones represents a typical "contact" ore deposit. The strike of the contact zone is roughly northeast and southwest with an apparent vertical dip. The ore-body is exposed on the surface for approximately 100 feet in length and 50 feet in in width. Development work consists of a main adit-tunnel, side drifts and slopes to an aggregate total of some 900 feet. The ore is chiefly composed of magnetite (Fe_3O_4) containing bornite and chalcopyrite in varying amounts, disseminated throughout the magnetite body. According to Mr. Knight, shipments made during mining operations carried as high as 5 per cent copper and small amounts of gold and silver. The estimated percentage of copper in the magnetite body is placed at $1\frac{1}{2}$ per cent, although selective mining has yielded copper ore considerably richer, as evidenced by the shipments made. At the time of the writers' visit, bornite masses 3 inches across were noted in certain portions of the magnetite.

It is interesting to note that besides the usual contact minerals, garnet epidote, etc., the mineral magnesioludwigite (a rare iron-magnesium borate), is also present. Tungsten, in the form of scheelite, was detected in small amounts with the ultra violet lamp in the main tunnel. However, from the preliminary examination it did not appear to be present in sufficient quantities to constitute ore. Because of the large body of magnetite and associated minerals, such as magnesioludwigite and scheelite, it is assumed that the mineralization is due to solutions emanating from igneous sources, and that the above minerals were transferred from the magma to the limestones adjacent to the intrusive mass.

The lack of adequate transportation facilities from Brighton on to the mine, plus the low value per ton of ore, makes it impossible to work the ore body profitably at present. The possibilities of this deposit being capable of yielding great tonnages of iron ore is problematical. Nevertheless, from all appearances this deposit represents a potential ore body of magnetite iron ore containing an appreciable percentage of copper and small amounts of gold and silver that may be of future economic significance.

Morgan Deposits

Very little information is obtainable relative to the ore deposits of this region, and inasmuch as the writers have not visited the area as yet, the foregoing is only a compilation of the data available in government publications. Heikes[1] gives the following statement regarding the iron deposits located near Morgan:

"Hardscrabble (Mill Creek) district, 10 miles southwest of Morgan on the Union Pacific railroad, was organized February 11, 1893. Long before this, however, the claims of the Norway Iron Mining and Manufacturing Company (incorporated Nov. 19, 1879) were operated, yielding some iron ore containing 56.12 to 65.08 per cent iron. Some of this ore was tried in the experimental iron furnace during the eighties at Ogden....Previous to 1900 no records are available of the iron ore shipped out of the district for testing at the iron works (operated for only a few weeks) near Ogden and the several car lots shipped to different smelters as flux."

Bishop[2] visited these deposits for the survey in the early eighties and states as follows:

"A company called the Norway Iron Mining and Manufacturing Company has been organized in the territory to work certain iron mines in the Mill Creek district, Morgan County. Three of the mines have been partially developed, and some 2000 tons of the iron ore are now on the dumps. From analyses made of the ore by Mr. John McVicker of Salt Lake City, it is found to contain from 56.12 to 65.08 per cent metallic iron. A sample of the brown ore from these mines was analyzed by Mr. F. M. Bishop, with the following results:

	Per cent
Metallic iron	56.00
Silica	3.00
Carbonate of lime	4.50
Alumina	4.3
Sulphur	Trace

Iron ores are mined in many other localities in the territory, being used in fluxing siliceous silver-lead ores."

Brigham and Ogden Deposits

The Brigham and Ogden deposits are best described as a unit, principally because they are located in relative proximity to each other. The area in which the iron ore occurs is in the Wasatch range between Ogden City and Brigham City, Utah. The ore deposits have been prospected and developed (to some extent) in the Willard and Weber mining districts. Hematite and magnetite are the chief iron-bearing minerals and are reported to exist as relatively large bodies of iron ore.

The geology of the area is complex, as the rock formations havebeen disturbed by extensive overthrust and transverse faults.

1/ The Ore Deposits of Utah: U. S. Geol. Surv. Prof. Paper III, p. 226, 1920.

2/ U. S. Geol. Surv. Mineral Resources, 1883-84, p. 288, 1885.

The Willard overthrust is well exposed between Ogden and Brigham where pre-Cambrian rocks have been thrust over Paleozoic sediments. The rock formations include pre-Cambrian granites, gneisses, schist and meta-quartzites, Cambrian quartzites, shales and limestones, and Carboniferous and Tertiary sediments.

"The Willard district has been described by Loughlin,[1] and his discussion of the iron deposits follows:

"The Willard mining district includes a considerable area east of Willard and on both sides of Willard Canyon. The prospected deposits include magnetite, copper and lead ores.

"Magnetite bodies have been prospected on the Twin Pine and Mormon Girl claims, which are on the south slope at the head of Threemile Canyon, the first canyon north of Willard Canyon. The ore bodies are local replacements of quartzite beds, which dip steeply eastward. That on the Mormon Girl claim contains films of malachite and azurite filling cracks and is said to assay about 5 per cent copper. It is opened by a shallow inclined shaft and a 70-foot tunnel, which show the ore to be a shattered replacement of quartzite. Quartz-muscovite veins trending in various directions are associated with the ore body.

"Specular hematite was noted in two beds of ferruginous schist in the lower quartzite member of the Algonkian. Their horizon extends from the foothills east of Willard, southward into the Sierra Madre district, where they are exposed high on the west slope of Eldorado peak. Microscopic examination of a specimen from one of the beds showed that it consisted mainly of quartz and hematite and a little muscovite. The hematite averaged about 25 per cent by volume of the rock."

Mr. F. C. Fisher of Ogden, Utah, submitted several hundred pounds of hematite ore of the ferruginous schist type, which he reports occurs in large quantities high on the spur between Threemile and Willard Canyons, east of Willard in the south half of section 13, T. 8 N., R. 2 W., S. L. B. & M. The deposits are covered by 100 patented claims which are under the control of the Wasatch Iron and Gold Company, a corporation of the state of Utah. Mr. F. C. Fisher is the owner of the majority of outstanding stock of the corporation. An analysis of this material showed 51.0 per cent iron and 25.2 per cent insoluble. Although the above analysis indicates a rather high silica content of the iron ore, the property deserves investigation.

Heikes[2] gives the following brief description of the iron deposits of the Weber mining district:

"The Weber district, in Weber County, known in 1860 as the Junction district, is two miles northeast of Ogden. . .A company organized to work large deposits of hematite and magnetite ore said to exist from three to eight miles north of Ogden, built a furnace and ran for a week in 1876."

Other deposits of hematite and magnetite of good quality, but unknown quantity, are reported to occur to the north and south of Ogden peak. Mr. F. C. Fisher of Ogden has holdings in this area. The iron deposits north of Ogden peak lie high on the south slope of Ogden Canyon and apparently occur as replacements in Carboniferous limestones. The location of the deposits south of Ogden peak is not known.

1/ The Ore Deposits of Utah: Prof. Paper III, p. 222, 1929.
2/ The Ore Deposits of Utah: U. S. Geol. Surv. Prof. Paper III p. 223, 1920.

Bear River Range

Mineral Point Deposit

The following discussion relative to the hematite occurrence at Mineral point was compiled primarily from notes taken by Buranek during a visit to the area in February, 1942. Inasmuch as the chief purpose of the trip was to examine the property controlled by the Mineral Point Copper Company, located amile or so to the north of the hematite deposit, only a few hours were allotted to the examining of the hematite. Therefore, the foregoing account is sketchy at best.

The Mineral Point iron deposit is controlled by the Super Steel Corporation, Luther S. Foss president. The property is located in East Canyon of the Bear River range in sections 24 and 25, T. 9 N., R. 2 E., Cache County Utah, in the Paradise mining district. Avon, the nearest settlement to the holdings, lies some nine miles by road to the west at an elevation considerably lower than the mine. The property is accessible from Avon over a dirt road which follows the east fork of the Bear River to the claims. The road during the winter months is difficult to traverse because of snow and mud, but in good weather it is reported to be readily passable by truck. As it follows the valley floor nearly to the property, there are no grades of importance encountered with the exception of the short distance where the road leaves the stream-bed and climbs to the claims.

General Geology

The regional geologic structure in the vicinity of Avon, which includes the southeastern part of Box Elder County and the southern part of Cache County, is extremely complex. The formations represented are highly faulted by eastwest breaks and are closely associated with the Willard overthrust, the frontal remnants of which are exposed to the west in the Wasatch range proper.

The sedimentary formations in the immediate vicinity of the mine include Brigham quartzite and Largston limestones and shales of Cambrian age. The Langston limestones, roughly 400 feet in thickness, are usually of a light neutral grey color, highly dolomitic, and varying in texture from compact to medium grained. The spence shale member, part of, and occurring near the base of the Langston formation, is even grained and tawny-black to neutral gray in color. It is reported that the Ute limestone is also present, but it was not apparent to the writer at the time of his visit to the property.

No igneous rocks are known to be present in the area under discussion.

Ore Deposits

The ore deposit consists almost entirely of pure coarsely crystalline, micaeous hematite existing as replacements in limestone. The deposit has been developed rather extensively by tunnels, side drifts, stopes, etc. The genesis of this occurrence is obscure but it may most logically be explained by the rising of iron

bearing solutions along major channels which, upon reaching the soluble limestones, formed large replacement bodies of iron ore. A secondary enrichment hypothesis seems improbable because hematite of this variety is generally attributed to primary mineralization. Further, it is not due to metamorphic agencies because there is a complete lack of metamorphism in the adjacent rocks.

Victor Peterson, a student of geology at the Utah Agricultural College at Logan, Utah, has devoted considerable time to the study of this iron-ore body and estimates some 900,000 tons of ore containing approximately 600,000 tons of iron to be present on the property. Although the writer is in no position to substantiate Peterson's tonnage estimate, from all appearance, this deposit is sufficiently large to have probable economic importance. The quality of the hematite is excellent as is evidenced by the analysis given below. Several samples collected from a stock-pile of ore near the loading bin, analyzed as follows:

Black and Deason, Salt Lake City
Utah, Analyst

	Per cent
Fe	64.2
Phosphorous	0.002
SiO_2	6.2

In view of the fine quality of the ore and its nearness to a railroad, this occurrence, although small as compared with southern Utah deposits, deserves further study.

Wah Wah Range

The Wah Wah range of mountains is a typical north-south trending range of the great basin province, located west of the San Francisco range in western Beaver County, Utah. The iron deposits, near Blonde Mountain peak, are roughly 20 miles southwest of Newhouse, in the southern Wah Wah Mountains.

In the early part of November, 1941, the range was visited by the writers in the company of Messrs. Hansen and Williams, geologists, during a one day reconnaissance of the iron deposits of the Blonde Mountain peak area. The following notes are a compilation of the information gained at that time.

Blonde Mountain peak is roughly one mile southwest of a U.S. public land survey monument corner, at the intersections of sections 19,20,29,30, in T. 29 S., N. 15 W. The iron outcrops were prospected by a number of tunnels, open-pit and glory holes in sections 29,30 and 31 of T. 29 S., R. 15 W. and 31 of T. 29 S., R. 15 W. and also in sec. 28, T. 30 S., R. 15 W. Some ore was reportedly shipped during the early "eighties" to the Frisco smelters for flux.

The geologic formations in the immediate vicinity of Blonde Mountain peak include both sedimentary and igneous rocks. The high ridge north and west of Blonde Mountain peak, is essentially a compact, massive quartzite which is overlain by shales and limestones of Cambrian age. Blonde Mountain is composed of a fine-grained rhyolitic rock. Whether it is a flow rock or a fine-grained intrusive into the sedimentary series is not certain, but

it is exposed for 1000 feet or more along the flank of Blonde Mountain. The iron occurrences are all located near the igneous mass suggesting a possible genetic relationship.

Ore Deposits

The origin of the ore deposits is not altogether clear, but there are several factors which indicate primary mineralization along definite channels. Most of the exposures of iron ore are replacement bodies in limestone, which more or less align themselves one after another in a northwest-southeast direction. The prospects show a similarity of strikes and dips further suggesting a possible connection between each other. Measurements made in the open-pits showed an almost consistant strike of N. 65 degrees W. and a general vertical dip away from the igneous mass that forms Blonde Mountain peak.

The iron ore is present as hematite and limonite with hematite being the predominant mineral. In the prospects, hematite occurs in both a massive and powdery form. A sample taken across the vein exposed in the largest workings, analyzed as follows:

Crismon & Nichols, Salt
Lake City, Utah, analyst

Fe	64.8
Insoluble	2.9
Sulphur	0.11
Phosphorous	0.009
Manganese	0.45
Gold	0.01
Silver	Trace

The southernmost deposits of iron were prospected by either tunnel or trenches which penetrated only short distances into the iron ore bodies. At these prospects very little data was obtainable relative to the iron ore in place, because the old workings were caved and no iron ore other than float was visible. Several tons of iron ore was present in a dump of one of the prospects and an examination of it showed that the chief iron minerals were hematite and limonite and possibly a small amount of magnetite. Much of the hematite is a dense black mineral, but occasionally masses contain open spaces partially filled with limonite. The latter mineral is usually dark in color and very lustrous having the appearance of a furnace slag. A few specimen of the limonite were noted which had tarnished, displaying irridescent colors.

No where in the area was it possible to see iron ore in place with the exception of the old workings. From the cursory examination made of these prospects, it appeared that the ore bodies are lenticular in nature, pinching and swelling along a mineralized fissure. They may, however, exist as a continuous vein of relatively uniform thickness, or a series of veins, exposed only in the prospects. The thickness of the iron bodies varied considerably from a few feet to 15 feet or more, substantiating the lenticular, limestone replacement hypothesis. A more comprehensive study of the area is necessary before positive statements as to the origin and size of the iron deposits can be made.

Miscellaneous Deposits

Pyrite, an iron disulphide, is not usually considered an iron ore, but limonite, concentrated from disseminated sulphides, has been an important fluxing ironore in the past. When pyrite is acted upon by the processes of oxidation, it undergoes a radical change and the resulting products, including ferrous and ferric sulphate, are extremely susceptible to migration in certain types of rocks. Under favorable conditions limonite, the hydrous iron oxide, precipitates from solutions carrying the iron sulphates, and occasionally large bodies of limonite thus form. Into this catagory fall the Dragon, Marysvale, and Lucin iron deposits and accordingly they are described as a unit. Even though none of these occurrences may be considered as economic iron deposits today they are included in this brief because of their past importance as fluxing agents for other valuable metals.

Dragon Deposit

The Dragon Iron Mine is located in the Tintic mining district near Eureka, Utah, in the Tintic range of mountains. All that remains today of the huge body of iron ore are a few scattered bunches of limonite along the sides of the glory hole or open pit. Other similar deposits of limonite exist in the district, but thus far, none have been found to compare in size with the Dragon deposit. Butler[1/] gives the following description of the deposit:

"At the surface this mine is an open cut, about 200 by 75 feet in area and over 200 feet deep. The ore body of the pit is said to end just below the 300 foot level. Small deposits of the limonite-kaolin mixture are found in the same mine as far down as the 800-foot level. The limestone porphyry contact slopes southward and eastward beneath the porphyry, and the limonite-kaolin masses thus far found are all in the limestone, at or very near the contact.

"The great body of iron ore occurs in irregular nearly vertical shoots, whose largest dimension trends approximately east or north. They are completely surrounded by masses of hard kaolin, which are penetrated along the margins by small offshoots of iron ore. The ore is a compact limonite, with perhaps some hematite, containing 55 to 57 per cent iron and 4.5 per cent silica. Much of it contains a trace of gold and as much as two ounces a ton of silver. Few copper stains have been observed.***

"The genesis of these deposits is attributed to the downward migration of aluminum, iron, and manganese sulphates leached from a great thickness of pyritic porphyry that formerly overlay the present surface. These salts upon reaching the limestone replaced it, forming kaolin, limonite and wad. The kaolin itself was in part replaced by the limonite and carried farther, thus forming the lower and lateral parts of the deposit. Rough calculation shows that the amount of pyritic porphyry was ample to supply the iron ore of even the large Dragon deposit."

1/ The Ore Deposits of Utah: U. S. Geol. Surv. Prof. Paper 111, p. 415, 1920.

Lucin Deposits

The Lucin iron deposits are located in the Lucin mining district, Box Elder County, Utah. The district lies at the northern end of the Pilot range of mountains a few miles south of the Southern Pacific railroad. The stations, Lucin, Utah and Tecoma, Nevada, are but a few miles northeast and northwest, respectively, from the district. The ore deposits were worked chiefly for their gold, silver, copper, lead and zinc content, but limonite was so abundant at one of the properties that a large quantity was shipped as fluxing ore.

Ore Deposits

The most impressive occurrence of iron ore in the district is that of the Copper Mountain mine, where large replacement deposits of oxidized copper and limonite ores were worked prior to 1876. At the time of the writers' visit to the property during September, 1942, there was no activity in the district. The data here given represent observations of surface workings supplemented by notes by previous investigators. The ore has made along a north-south fault zone near the western margin of a truncated granitic intrusive and is locally associated with a later diabase dike. The dike is prominently exposed along the fault zone and is roughly 40 feet in thickness. Development of the ore body consists of both underground and open cut workings. Most of the ore, however, was apparently taken from the open cuts. Butler 1/ gives the following description of the character and nature of the ore:

"The ore thus far developed is entirely oxidized, consisting of hydrous oxides of iron, oxide of copper, 'copper pitch' (a black substance containing copper and manganese), carbonates of copper, silicate of copper, and a large amount of clayey mineral that is white to dark blue, according to the amount of copper it contains.2/

"The character of the ore differs greatly at different points: for example, the southern part of the east ore body is mainly hydrous iron oxide which contains little copper, but which is so high in iron that a large quantity has been shipped as fluxing ores.*** The ore was doubtless formed by the oxidation of bodies of iron and copper sulphides, though neither was seen in the mine, the oxidation being unusually complete.

"The ore body outcrops prominently, and much ore has been extracted by open-cut methods. The ore thus far mined has been in two bodies, separated by a relatively barren zone. The eastern wall of the eastern deposit is formed in part by the diabase dike. Prospecting east of the dike has failed to find ore in important amounts."

Limonite is common in other mines of the district, but none of them contain as large a body as that mentioned above. It is

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1/ The Ore Deposits of Utah: U. S. Geol. Surv. Prof. Paper 111, pp. 492-3, 1920.

2/ In addition to the minerals listed by Butler, cuprite and native copper were observed by the writers associated with this clayey material grading into chrysocolla.

doubtful, however, if the Copper Mountain Mine will ever be worked primarily for its iron content, because although it is unusually large compared with southern Utah iron deposits.

Marysvale Deposits

The Marysvale iron deposits are located in the Antelope range near Marysvale, Piute County, Utah. The Krotki Iron Mine has produced some iron and manganese ores which were shipped to local smelters for flux. As the writers are not familiar with the iron occurrences the foregoing account is quoted directly from Butler's[1/] description of the deposits.

"Some shipments have been made from deposits of iron ore in the quartz latite body in the central part of the Antelope range. The ore bodies occur in irregular fissures. The quartz latite in the vicinity has been highly altered, being converted to a cherty mass. This body of silicified rock has been more resistant to erosion than the surrounding rock and stands up as a hill several hundred feet high. The iron deposits are near the summit of the elevation and near the center of the area of altered quartz monzonite. The silicified area is irregular but probably exceeds a mile in length from north to south and is fully half a mile in width. The altered rock is composed essentially of quartz with small amounts of oxides of iron and possibly manganese.

"The ore consists of yellow and reddish earthy hydrous oxide of iron, with some brown and black hydrous oxides of manganese and iron, and some beautifully formed stalactitic masses of limonite. The ores, as they now exist, appear to have been formed by the alteration of other minerals. In general the deposit does not differ markedly in appearance from the gossans formed by the oxidations of sulphide bodies. No remnant of sulphide were observed in the ore, nor was sulphide noted in the adjacent wall rock. Considerable iron oxides, together with other bodies, were evidently removed from the monzonite during the alteration and this may have collected in the fissures and formed the bodies of iron ore."

1/ The Ore Deposits of Utah: U. S. Geol. Surv. Prof. Paper 111, p. 546, 1920.