SOME CERUSITE DEPOSITS IN CUSTER COUNTY, COLORADO.

By J. FRED. HUNTER.

INTRODUCTION.

The following notes are based on information gained during a visit of two days in June, 1913, to the zone of cerusite deposits along Oak Creek in the vicinity of Ilse, Custer County, Colo. One day was spent in examining the Terrible mine, the most important development along this zone, and one day in examining prospects and in studying the character of the zone.

These deposits were first described by S. F. Emmons,[1] who visited the area in 1887 and stated that "the only metallic mineral in the deposit was the white carbonate of lead, or cerusite, which occurred lining the cleavage plane or cracks between the lozenge-shaped fragments of country rock and in some cases as seams or veins a fraction of an inch wide running through the mass or following the footwall." He also noted the absence of sulphides, stated the mineral deposition to be "simply the filling of interstitial spaces in a zone of shattered and altered rock, with possibly a certain amount of replacement of the original minerals," and finally suggested "the transposition and concentration of deep-seated deposits of sulphide by carbonated waters, such as are now issuing at the surface in the canyon of Grape Creek 3 or 4 miles to the westward."

A further reference to the deposits was made in 1907 by R. B. Brinsmade,[2] who described the Terrible mine and offered the curious conjecture that the lead had been derived from "beds of limestone or small veins in the schists" presumably rich in galena and had been deposited as cerusite in the cracks of the gneiss by descending waters. In this way he explained the absence of any galena, even on the 250-foot level of the Terrible mine.

GEOGRAPHY.

The cerusite deposits here described extend in a narrow belt for several miles along the east side of Oak Creek, in the northeastern part of Custer County, Colo., about 12 miles northeast of Silver Cliff.

[1] Emmons, S. F., The mines of Custer County, Colo.: U. S. Geol. Survey Seventeenth Ann. Rept., pt. 2, pp. 468–469, 1896.

[2] A curious deposit of cerusite in Colorado: Eng. and Min. Jour., vol. 88, pp. 844–845, May 4, 1907.

The best-known and apparently the richest portion of this zone is in the vicinity of the Terrible mine, close to the nearly abandoned town of Ilse (once known as Spaulding). Prospecting has also revealed considerable ore in the vicinity of Lead Hill, about 2½ miles southeast of the Terrible mine, near the head of the east fork of Oak Creek and on the divide between it and Parker Gulch, a tributary of Hardscrabble Creek. For the most part the deposits occur along the foot of the steep western slopes of the Wet Mountains, a granitic ridge over 9,000 feet in elevation, extending north-northwest to the Royal Gorge of Arkansas River and forming in this locality the Front Range of the Rockies. West of the cerusite belt the low shoulders from these mountains slope gradually to Oak Creek, which in few places is over a third of a mile distant. Oak Creek in this vicinity ranges from 8,100 to 8,400 feet in elevation and flows for the most part through an open cultivated valley, west of which the slopes rise gradually to the divide between it and Grape Creek. At Yorkville, about 5 miles north-northwest of Ilse, Oak Creek turns sharply to the northeast and enters a canyon, from which it emerges to empty into Arkansas River a mile above Florence.

The nearest railroad station is Westcliffe, the terminal of a spur which leaves the main line of the Denver & Rio Grande Railroad at Texas Creek. Westcliffe is 16 miles southwest of Ilse and is connected with it by a moderately good road. Probably the best outlet for the area is at Chandler, the terminus of another short spur line of the same railroad, 17 miles north of Ilse over a good wagon road, most of which is down grade. Rockvale is 18 miles and Canon City, on the main line, 22 miles from Ilse. A branch of the Denver & Rio Grande Railroad which ran up Grape Creek was abandoned in 1888. The post office of Ilse was formerly at the Terrible mine, but after the cessation of activities there it was removed to a ranch about half a mile farther up the valley.

The area lies practically in the center of the Canon City quadrangle, the topography of which was surveyed in 1889 and mapped on the scale of 1 : 125,000. Six or seven miles to the southwest is the northeastern boundary of the Silver Cliff and Rosita Hills area,[1] which has been mapped topographically and geologically on the scale of 1 : 20,000.

HISTORY.

The cerusite belt is said to have been discovered about 1879 by a Mr. Rain, who, with his partner, a Mr. Spaulding, located what is now the Terrible mine. During the period from 1884 to 1889 concentrates were shipped by the Omaha & Grant Smelting Co. from this mine to

[1] Cross, Whitman, Geology of Silver Cliff and the Rosita Hills, Colo.: U. S. Geol. Survey Seventeenth Ann. Rept., pt. 2, pp. 263-403, 1896.

Blackburne over the now abandoned Grape Creek road. This was the period of greatest activity in the area, and during it considerably over $500,000 worth of lead was extracted. In 1889 activities at the Terrible mine ceased, owing in part at least to the washing out of the railroad, and nothing more was done until 1897.

During the three years subsequent to 1897 S. H. Baker leased the Terrible property and is said to have extracted about 1,000 tons of ore, running about 5 per cent of lead. During a portion of this time the ore was roasted and converted into litharge. In 1903 the mill, shaft house, and adjoining buildings of the Terrible mine were destroyed by fire, and little or no work has been done since, although several unsuccessful attempts have been made to renew operations. In 1907 the present machinery was installed and the water pumped out, but nothing further was done. In the summer of 1913 the water was again pumped out and examinations were made preparatory to a renewal of operations. At the date of writing, however, the mine is still idle.

Several smaller mines along the cerusite zone have shipped a little ore from time to time. Probably the only one of these deserving mention is that on the Wild Girl and High Kicker properties, near Lead Hill, located about 1887 by Alexander Hall and worked periodically by him until 1893. The shipments from this mine are said to aggregate about 80 tons of concentrates.

Estimates of the total production of the belt vary from $500,000 to over $1,000,000 worth of lead. Except for the record of 3,000 tons of lead produced in the year 1883,[1] no authenticated statistics of the annual production are available. R. B. Brinsmade[2] is authority for the statement that the Terrible mine had "produced some 250,000 tons of ore, from which over $500,000 worth of lead concentrates were extracted and shipped." According to S. F. Emmons,[3] the mint reports up to 1895 showed a production for the Terrible mine of $759,717 worth of lead, all of which went to a single smelter.

GEOLOGY.

GENERAL FEATURES.

The country in the vicinity of the cerusite belt is formed chiefly of granite, in the main of a markedly gneissoid character, which has been intruded by dikes and small bodies of syenite, diorite, pyroxenite, and perhaps other types of rocks. In the short time and with the poor base map at the disposal of the writer, only the most general observations could be made. However, Cross[4] has described the adjacent

[1] U. S. Geol. Survey Mineral Resources for 1885, p. 256, 1886.
[2] Loc. cit.
[3] Op. cit., p. 420.
[4] Cross, Whitman, loc. cit.

Silver Cliff and Rosita Hills area, where a basement of ancient gneisses and granites, cut here and there by dikes and stocks of syenite, diabase, and diorite, is covered in large part by volcanic rocks of massive and fragmental character, chiefly rhyolites, trachytes, dacites, and andesites. Except for alluvium, local and probably recent lake beds, and stratified rhyolitic tuffs of the Silver Cliff Basin, no sedimentary formations were found in that area.

In the portion of Oak Creek valley examined by the writer no sedimentary or volcanic rocks were observed, and an examination of the float and talus on the western flanks of the Wet Mountains adjacent to the cerusite belt, as well as the form of the exposures, indicated that they consist largely of the gneissoid granite.

The age of the gneissoid granite is not definitely known, but the occurrence of somewhat similar granites underlying Ordovician formations and containing numerous large fragments of Algonkian quartzite in the Pikes Peak quadrangle,[1] which lies immediately north of the Canon City quadrangle, makes it probable that they belong to the Algonkian or early Cambrian. The gneisses west of the cerusite belt, which are cut by these granites, may be Archean, although there is no direct evidence on this point. The age of the syenites, diorites, and pyroxenites presently to be described is also indeterminable.

PETROGRAPHIC CHARACTER OF THE ROCKS.

Granite.—The prevalent rock in the vicinity of the cerusite deposits is granite, which locally is much crushed, altered, and iron stained. At a short distance away from the metallized belt, however, the rock is fresh and of pinkish color, with numerous dark spots or streaks. Its texture is slightly porphyritic to equigranular or aplitic and of medium grain. The granites on the west side of the zone appear to be more crushed, more gneissic, and more distinctly banded than those on the east side of it. Pinkish feldspar, translucent quartz, and dark-green biotite are the chief minerals of the granites and can easily be distinguished with the unaided eye. The microscope shows that the constituent minerals of these rocks range from 1 to 5 millimeters in diameter and are allotriomorphic—that is, they are without definite crystal boundaries. Feldspar is slightly more abundant than quartz. Biotite and locally muscovite occur in subordinate amounts. The feldspar consists chiefly of orthoclase, microcline, and microperthite, with a small proportion of soda plagioclase, and is in part altered to sericite. Micropegmatite, apatite, and magnetite or ilmenite occur in meager quantities as accessories.

[1] Cross, Whitman, U. S. Geol. Survey Geol. Atlas, Pikes Peak folio (No. 7), 1894. In this folio the formations now known to be Ordovician were included in the Silurian.

Syenite.—At two places along the belt syenite dikes very closely resembling those in the Silver Cliff district were observed. They are conspicuous even from a distance, owing to the red color of their outcrops. A typical example of such a dike is on a sharp spur three-fourths of a mile southeast of Putnam Bros.' ranch house, only a short distance west of the altered cerusite-bearing zone. This dike is 10 feet wide, runs N. 15° W., and can be traced for several hundred yards. The rock is of brick-red color, of fine grain, and of slightly porphyritic texture, a few scattered platy crystals of red feldspar or long needles of dark-greenish amphibole being noticeably larger than the other constituent minerals. Microscopic examination shows the rock to be of allotriomorphic texture and to consist in large measure of feldspar, chiefly orthoclase with undetermined amounts of soda plagioclase. Both feldspars are equally impregnated by fine particles of hydrous iron, which impart the red color and obliterate certain characteristics that are of diagnostic importance in their study. Biotite, magnetite or ilmenite, apatite, epidote, and amphibole are present in subordinate or accessory amounts.

Diorite.—Here and there along the cerusite belt are small bodies of intrusive diorite, the best examples being found on the west side of the open cut at the Terrible mine and on the west side of the southeast fork of Oak Creek, three-fourths of a mile south of Putnam Bros.' ranch house. These bodies are dikelike in form, but as a rule are poorly exposed. The occurrence at the Terrible mine is typical, although it has suffered considerable weathering and alteration near the surface. It is approximately 25 feet wide and appears to run a little west of north, parallel and contiguous to the cerusite-bearing zone. Much of the rock is highly altered and is greenish gray on fracture surfaces, with yellow and brown stains. Where weathered, as in the open cut of the Terrible mine, it is soft and disintegrates easily into rather coarse granular fragments. A fresh specimen obtained near the bottom of the Terrible shaft is nearly black in color, of moderately fine grain, and of uniform texture, and hornblende and feldspar are easily distinguishable in it. The microscope shows that this rock is made up of rather well formed crystals from 0.5 to more than 1 millimeter in diameter. Plagioclase of the composition of calcic andesine is present in slightly greater abundance than hornblende, and these, with a much smaller amount of augite, are the principal mineral constituents. Magnetite in moderately large grains is a relatively abundant accessory, but apatite and pyrite are to be found only here and there. Small amounts of quartz and orthoclase were observed in one of the specimens of diorite studied. In the process of alteration the feldspars have been partly changed to fine sericitic aggregates, while the hornblendes and

augites have been deeply stained with hydrous iron, particularly along the cleavage cracks, and in extreme cases have been rendered opaque. Biotite was seen in one slide and is apparently an alteration product of hornblende.

Pyroxenite.—An interesting rock occurs in a small pluglike mass on the east slope of the southeast fork of Oak Creek about 2 miles southeast of Putnam Bros.' ranch house and a short distance west of the High Kicker claim. The exposure is an odd-looking rounded protuberance about 6 feet in diameter, projecting several feet above the surrounding slope. The rock, which intrudes granite gneiss, shows a rough and pitted surface, mostly stained brown or red by iron. On fresh fractures it is black and coarsely granular with large platy crystals of pyroxene which on very close inspection show a mottled surface sometimes called "luster mottling." Microscopic study of one section of this rock showed its individual minerals to average more than 5 millimeters in diameter, to be of irregular and even ragged outline, and to possess a poikilitic structure, that is, it shows inclusions and intergrowth of small particles of one mineral in the larger crystals. The section examined consists largely of hypersthene, with a smaller amount of hornblende and still less olivine, magnetite, and serpentine. The hypersthene shows numerous inclusions or intergrowths of green hornblende. The serpentine fills small cracks and veinlets through the rock and has resulted in part from an alteration of the olivine.

The unusual rock here described belongs to the pyroxenites and suggests certain hypersthenites from Canada and Montana. It is also similar to a peridotite occurring on the northern bank of Cottonwood Gulch east of Querida, near the Hector and Mountain Boy mines, described by Cross.[1] In that rock, however, the olivine and hornblende predominate over the hypersthene, and biotite and plagioclase are present in small quantities. A further study of thin sections from this mass might well reveal larger proportions of olivine and greater similarity to the peridotite.

STRUCTURE.

The rocks of the portion of the Oak Creek valley adjacent to the cerusite belt are granites and granite gneisses intruded here and there by the rocks just described. Only where the gneissic character has been well developed and a marked banding produced can they be said to possess any structure. Although this character is not everywhere manifest and has not been studied in any detail, the observations so far made point to a possible interesting fault relation. The banding or gneissic structure, noted on the east side of the cerusite-bearing zone, trends in general a little west of north, parallel to the zone, but on the west side the structure shows a tendency to a northeasterly or

[1] Cross, Whitman, Geology of Silver Cliff and the Rosita Hills, Colo.: U. S. Geol. Survey Seventeenth Ann. Rept., pt. 2, p. 283, 1896.

easterly trend such as exists in the gneisses of the Silver Cliff area. Furthermore, this zone extends in a north-northwest direction through small saddles and over gently sloping shoulders at the foot of the abrupt, scarplike slopes of the Wet Mountains, separating the rugged topography on the east and a somewhat gentler surface on the west and thus suggesting a fault zone. Finally the cerusite belt itself shows a notable amount of crushing, with slickensided surfaces in numerous places, and is characterized by gouge, clay selvage, and alteration. For these reasons it is believed that the cerusite zone corresponds to an ancient fault of no small proportions. Owing to the absence of bedded deposits or other structural features than those noted, no idea can be obtained of the character of this fault, or of the amount of displacement effected by it.

MINERAL ZONES.

The only mineral deposits examined in this hasty reconnaissance were the cerusite bodies on Oak Creek. These deposits, where seen, are chiefly localized along zones of faulting and crushing in the granite and granite gneiss. The most important of these zones is the one along the foot of the steep scarps of the Wet Mountains, extending from the Terrible mine in a south-southeasterly direction for at least 2 miles. Near the head of the southeast fork of Oak Creek, in the vicinity of Lead Hill and extending through the Wild Girl and High Kicker properties, is another cerusite-bearing zone, in similar rocks, which probably runs nearly parallel to the first, but appears to be too far east to be a continuation of it. This zone likewise shows evidence of faulting and crushing. A trip southeastward over Lead Hill into Parker Gulch revealed so much cerusite strewn over the slopes as float that the existence of other bodies and zones of cerusite than the two mentioned seems very probable.

The zone first noted can be traced from the Terrible mine, where it is best exposed and northwest of which it is reported to be lacking, in a S. 20° E. direction along the east side of Oak Creek for nearly 2 miles, to a point where it swings somewhat to the east. At the southernmost locality examined, three-fourths of a mile south of Putnam Bros.' ranch house, it runs in a S. 50° E. direction. This zone, which is believed to be coincident with the fault zone described above, is conspicuous even from a distance by reason of the line of yellow, iron-stained exposures and prospects along it.

In the open cut at the Terrible mine the zone consists of about 75 feet of crushed, altered, and iron-stained granite and granite gneiss carrying cerusite, striking N. 20°–25° W. and dipping about 60° SW. It shows a well-marked slickensided and striated plane on the east or footwall side, beyond which there is little if any cerusite, although alteration and oxidation have been effective for some distance

farther. On the west or hanging-wall side the pay zone is bordered by about 15 feet of clay gouge with brecciated fragments of altered granitic material. Beyond and parallel to the gouge there is a dike-like body of diorite at least 25 feet wide, which at the surface appears as a soft crumbling mass of blue to greenish-gray material to which tricks of weathering have added all sorts of yellow and brown tones. Several small lenticular masses of granite that may be either intrusions or inclusions are contained in the diorite, which on the first level of the mine is comparatively fresh and unaltered, as described above. The clay gouge and diorite are totally without minerals of economic importance and constitute what is known locally as the "barren zone" or "the gouge." Figure 4 represents a section across the open cut of the Terrible mine.

For 2 miles south of the Terrible mine the so-called cerusite zone can be followed almost continuously and ranges from a belt 80 feet in maximum width at this mine to a mere band of slightly altered

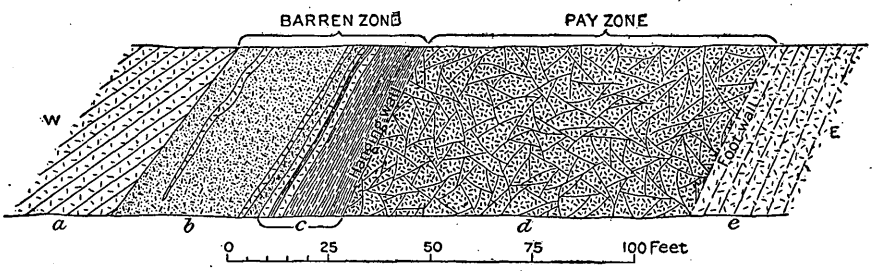

FIGURE 4.—Section across the cerusite belt near Ilse, Custer County, Colo., at the open cut of the Terrible mine. *a*, Gneissoid granite; *b*, disintegrated diorite; *c*, clay gouge with fragments of granite material; *d*, crushed, altered, and iron-stained granite with calcite and pockets of cerusite; *e*, granite.

and iron-stained gneiss only a few feet across. In several places prospects reveal a narrow zone of intensely crushed rock consisting chiefly of clay gouge, feldspathic material, calcite, and chloritic micas with limonite and manganese stains. On either side of such a zone, which is rarely over 10 feet wide, the granite gneiss may be considerably altered, although as a rule it is but little crushed and grades into fresher rock. Small amounts of cerusite are said to occur here and there along this portion of the zone, but the writer failed to observe any in the few prospects examined.

The other important cerusite-bearing zone visited is that crossing Lead Hill and the High Kicker property. The country rock here is chiefly granite and gneiss, the latter in places being rather micaceous and containing one narrow band of very hornblendic gneiss. The exposures and prospects were not such as to permit conclusive statements, the critical portion of the High Kicker mine not being open for examination at the time of visit. However, several small open cuts above the mine indicate an ore body whose strike probably approxi-

mates that of the Terrible zone—N. 15°–25° W.—and which dips westward at a relatively small angle, possibly 30°–45°. In two of the prospects there is a well-marked hanging wall of little altered gneiss whose banded structure is discordant with that of the underlying altered zone. Next below the hanging wall is a seam of gouge 10 to 14 inches thick, under which is crushed and altered gneissoid granite that carries the cerusite. No sharp change of rock or structure indicative of a footwall was found. The cerusite is said to become gradually less abundant eastward from the hanging wall. The width of this ore-bearing zone could not be ascertained, although it does not appear to be comparable to that at the Terrible mine. To the south a line of cerusite float, thought to be a continuation of the High Kicker body, could be followed for at least a quarter of a mile, and to the north of that property there is said to be on the same lead a small working which at one time shipped a small amount of cerusite ore. Although the parts of this zone examined indicate neither the degree of shattering and alteration nor the width that characterizes the Terrible zone, the ore-bearing portion appears to persist for a greater distance along it.

ORE DEPOSITS AND MINERALS.

Although the zones of alteration are extensive, they are cerusite bearing only in certain portions. In the 3 miles or more of the cerusite belt passing through the Terrible mine, the only economically important occurrence of ore so far known is at that mine. Even here the cerusite seems to give out within a short distance toward the south and probably within a somewhat greater distance toward the north, so that the deposit has the character of a shoot, roughly elliptical in plan, plunging to the northwest at an angle of approximately 60°. The shape of the ore body or bodies in the vicinity of Lead Hill can not be known until further development work has been done.

Everywhere throughout the zones of alteration studied the exposures indicate extensive oxidation, the yellow ferrous hydrate with calcite being almost invariably present. The portions of the zones carrying cerusite show extensive crushing, leaching, and infiltration of surface material in the upper weathered parts. A honeycombed structure of limonite and granitic material, together with numerous black manganiferous stains and dendritic wad, such as is typical of the gossan or oxidized portion of veins, is common. Streaks and veinlets of chert and chalcedony occur in small quantities here and there throughout the mineralized portions of the rock. The microscope shows the material of the zone of crushing to be chiefly calcite in very fine grains, a small fraction of a millimeter across, in a fine meshwork of limonite and iron stained material. Small patches of

chalcedony together with altered fragments of feldspar, quartz, and mica, all constituents of the original granite, are very abundant. The specimens from the 200-foot level of the Terrible mine show somewhat less calcite and limonite and lack the strongly leached, honeycombed structure of the more superficial parts of the zone. The 250-foot level, the lowest working of the mine, was inaccessible, but the deposits there are said to be similar to those nearer the surface, except that the percentage of lead is somewhat lower.

The ore mined is reported to have averaged from 5 to 8 per cent of lead and was capable of being concentrated to a product running from 60 to 70 per cent of lead. The assays are said to have reported, in addition to lead, a small amount of silver, but no zinc, arsenic, antimony, or sulphur.

Cerusite (the carbonate of lead, $PbCO_3$) is the only valuable mineral of the deposits under discussion which is present in abundance. It occurs as a gray to white heavy massive or granular mineral with numerous good cleavage faces that exhibit adamantine to vitreous luster. It can be distinguished by its high specific gravity and its solubility with effervescence in dilute nitric acid, also by the fact that it yields globules of lead when highly heated. No traces of a remnant of galena could be discovered in the cerusite. It is deposited in the interstices in the zone of shattered and altered rock, where there has been little if any replacement of the original minerals. It occurs in lenses, stringers, threads, and small pockets of diverse shapes along the cracks and jointings of the country rock. Few of these masses are over an inch or two in thickness, although exceptional pockets are 6 or 8 inches across, and even larger masses up to 115 pounds are reported.

One specimen of phosgenite (a chlorocarbonate of lead, $(PbCl)_2CO_3$ or $PbCO_3.PbCl_2$), carrying 81.9 per cent of lead oxide, was obtained. This mineral, which contains nearly as much lead as cerusite, is somewhat rare. As found at the Terrible mine it is dark brown and translucent and has perfect cleavage and adamantine luster. It occurs within a mass of cerusite, and so far as could be determined from one thin section the two minerals appear to have been deposited contemporaneously.

A very little hematite was found on the first level of the Terrible mine, and a few copper stains were observed in the open cut near the hanging wall. A minute particle of sulphide, thought to be chalcopyrite, was found along the zone of alteration on the slope southeast of Putnam Bros.' ranch house, but no other sulphides or sulphates of any kind were observed or are known along this zone, not even, it is said, in the lowest working of the Terrible mine. Indeed, drill holes to greater depths than the Terrible are reported not to have found sulphides.

GENESIS OF THE ORES.

With the growth of knowledge concerning ore deposits, the suggestion offered by Emmons in 1895 that this cerusite has resulted from "the transposition and concentration of deep-seated deposits of sulphides by carbonated waters, such as are now issuing at the surface in the canyon of Grape Creek 3 or 4 miles to the westward," has become less probable. So far as the writer has been able to learn no considerable amount of cerusite is known to have been deposited from springs. Indeed, the lead carbonate is difficultly soluble, as is demonstrated by its occurrence in the soil of Lead Hill.

The mines along the cerusite belt have not been worked to any great depth, so that only the upper portion of the ore deposits known as the oxidized zone has been opened for examination. However, the form and character of the deposits here described indicate that they have originated as veins formed along one or more zones of faulting. The crushed and shattered materials of these zones have afforded effective channels for the circulation of surface waters, so that oxidation has been carried to a somewhat greater depth than in the neighboring lead veins. If this hypothesis is correct, galena, from which the cerusite has very probably been derived, should be expected with increasing depth. The reported occurrences of galena veins on Oak Creek 3 miles above Ilse (at the Francklyn mine), on the west slope of the creek, not far from the Terrible mine, and in the vicinity of Yorkville, together with the occurrence of the meager trace of sulphide (chalcopyrite?) along the belt as described, lends credence to this view. It is of course possible that the galena represented an enrichment of the upper parts of the veins and that oxidation has involved all of this enriched zone, leaving only low-grade sulphides below. The workings accessible at the time of visit threw no light on this question. So far as known there is no other mine in the district which exhibits as deep oxidation as the Terrible.

MINES OF THE CERUSITE BELT.

TERRIBLE MINE.

The only important mine of the district is the Terrible, on the east side of Oak Creek at the former town of Ilse, less than half a mile north of the present Ilse post office. The property consists of a group of patented claims with mill sites aggregating 45 acres lying in secs. 17, 18, 19, and 20, T. 21 S., R. 70 W., and is owned by the Oak Creek Mining & Reduction Co. of New York. The workings consist of a large open cut or quarry, together with underground crosscuts, drifts, and stopes. (See fig. 5.) The quarry is about 50 feet deep, more than 300 feet long, and 115 feet across at its widest part, but narrows at either end and toward the bottom, where it is 75 feet wide. An

incline from the west, about 100 feet long, formerly served as a haulway from the bottom of the open cut. West of the quarry, on the hanging-wall side, a shaft, which was aimed to cut the ore body at a depth of about 550 feet, has been sunk 250 feet. From this shaft crosscuts have been driven in a northeasterly direction to the ore body at the 200 and 250 foot levels. Drifts have been cut from these levels, chiefly to the north, and considerable stoping has been done, the first level having been stoped out within 15 feet of the bottom of the quarry. The Terrible mine is reported to take in an average of

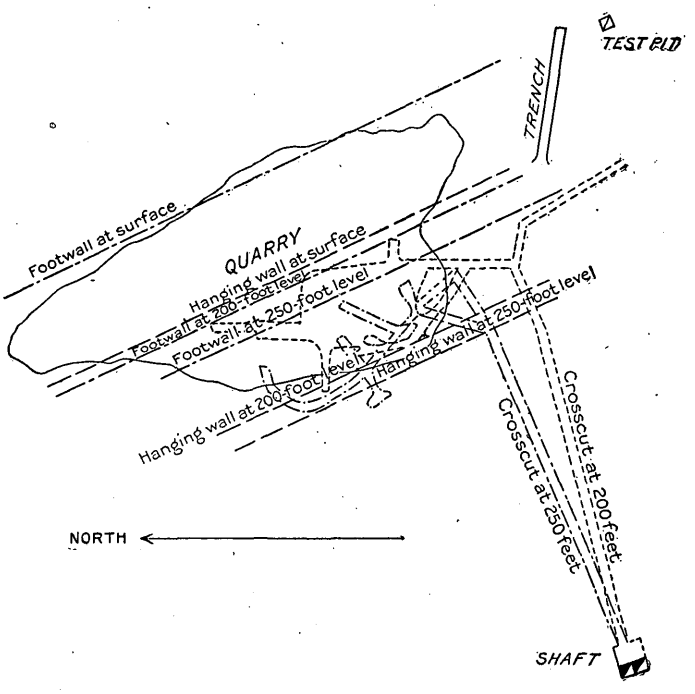

FIGURE 5.—Plan of the Terrible mine, near Ilse, Custer County, Colo.

280 to 300 gallons of water a minute, which, when not pumped out, will fill it within 50 feet of the surface.

The mill, shaft house, and adjoining buildings were destroyed by fire in 1903, and the present surface equipment consists of hardly more than temporary machinery for pumping. The ore was formerly concentrated by the use of the ordinary crushers, sizers, jigs, and tables, and during the last days of activity the concentrates were converted into litharge by means of a small brick reverberatory furnace and a pebble grinder. Though containing more or less impurity, the litharge produced in this way by one heat is said to have been of superior quality, particularly for use in vulcanizing rubber and as a chemical reagent, owing to its freedom from shots of metallic lead.

WILD GIRL AND HIGH KICKER CLAIMS.

The development of second importance along the cerusite belt is that near Lead Hill, on the claims known as the Wild Girl and High Kicker, lying in the N. ½ sec. 33, T. 21 S., R. 70 W., of the sixth principal meridian. These two claims were located by Alexander Hall about 1887. From that time until 1893 he mined cerusite periodically, chiefly by drifting, concentrating his ore by use of a hand jig and shipping in all about 80 tons of concentrates. The ore-bearing portions of the mine were for the most part fallen in at the time of the writer's visit. A number of prospects, pits, drifts, and tunnels had been driven in the vicinity in an effort to locate the ore body. The property is said to have been patented about 1898 and is now in the possession of Sylvester G. Williams, of Denver, who has recently done some work preparatory to further exploration and development.

OTHER CLAIMS.

Numerous prospect shafts, drifts, and tunnels have been driven at different places along the cerusite belt in search of ore. Several of these prospects visited by the writer showed little or no indication of the presence of ore. A very large portion of the zone of alteration is superficially, at least, barren of valuable deposits.

Two claims known as Moore's property, north of the High Kicker lead and thought to be on it, are said to have shipped in 1908 a small quantity of ore which had been concentrated by hand jigging to material containing 63 per cent of lead. The development on these claims, which were located some 20 years ago and are now held by A. D. McKenzie, of Greenwood, Colo., is reported to consist of a 40-foot shaft and a 50-foot tunnel.