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WALDEMAR LINDGREN'S 1899 REPORT ON FLORIDA MOUNTAIN

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The Silver City area was famous for the early 1864-1875 bonanza period, and had become an important mining district again ten years before Waldemar Lindgren made his excellent 1899 report.[1] The Trade Dollar Company on Florida Mountain continued to produce for another ten years. In 1976 open pit mining began at nearby De Lamar, and on Florida Mountain mining will be resumed after eighty years of relatively little activity if proposed plans are carried out. More recent operations will certainly add luster to the past record. Historical and present importance of the area is thus clearly established.

Although Silver City, the old mining camp--nearly a ghost town--survives, little remains to mark the sites of past large scale mining operations. All is gone except mine dumps and a few crumbling foundations where mills and other surface plant buildings once stood. The more significant archaeological evidence left on the surface of Florida Mountain, other than a few important tunnel sites, is the rock and ore specimens found on mine dumps. But the underground archaeological site is more important because it contains what mining actually involved: the miles of tunnels, shafts, raises, winzes, and stopes used to extract ore; the tools or equipment lost or left underground which help to explain how miners worked; and the kinds of rocks and ores described by Lindgren.

Mine workings and equipment used will be considered in a separate part of the archaeological site description. This section will deal with Lindgren's contribution to understanding mining exposures of Florida Mountain mineral deposit structures. A lengthy but necessary summary of Lindgren's report--primarily as it concerns Florida Mountain--has been prepared to indicate rock and ore specimens that should be recovered and to show why they are important. For example, alteration of basalt enclosing veins is "radically different from that of basic rocks near gold quartz veins of California" and other places in Idaho.

The practical value of Lindgren's report to contemporary and present mining enterprise is quite evident. Other cultural values, perhaps less tangible, are nevertheless inherent and substantial. This report by a distinguished geologist is, of course, part of mining history regardless of uses or whether with the advance of science it may in places be proven in error or merely inadequate. Relevance to history and pure science suggest the need to recover pertinent specimens and related data to lend greater validity to Lindgren's observations or to make new interpretations.

The ground encompassed on the surface and at depth on Florida Mountain constitutes a large archaeological site. Besides old roads, trails, mine dumps, ore bins, and foundations of the mine and mill surface plants, the surface site includes any remains that might indicate locations

of offices, boarding houses, or bunkhouses. All of the above features need to be described, photographed, mapped, and measured even though some of them are not within the impacted area. The need to recover samples of ore and country rock from mine dumps and surface workings has been mentioned in the summary of Lindgren's report. If it is not too late to do so, the position, width, and length of all surface workings should be recorded. Erosion, road construction, and other surface disturbance of more recent times may have obscured some of the early activity.

CHAPTER III

Page 134 Booneville Mine

The underground workings described here is the extent of them in 1898 when Lindgren was there. Work had stopped at the property in 1897. These claims are the Owyhee, Treasury, Seventy-nine, Humboldt, and others further north. All were owned by the Florida Mountain Mining and Milling Company at this time. In later years after the Trade Dollar Company acquired the property and mined at least as far north as the Humboldt shaft, the underground workings would certainly be more extensive than those shown in the 1898 plan of underground workings (PL XXIV). The Trade Dollar plans of underground workings and the manager's reports fail to show the full extent or the levels at which all of the exploration or stoping was carried on. Irwin does state that the northern claims were proportionally more productive and exceeded his optimistic expectations in the quantity of good ore discovered.

Except for comments about the difficulty and expense of mining large deposits containing only narrow seams of good ore, the Trade Dollar reports and records provide very little description of ore and country rock. Consequently Lindgren's description still appears to be the only detailed and reliable information available. Some good specimens of ore typical of that mined as late as the 1904-1908 Trade Dollar operations should be recoverable from the old workings. As Lindgren pointed out and the Trade Dollar discovered, values in the rhyolite were spotty. Narrow seams of good ore between masses of nearly barren rock could not be mined profitably and were therefore left in the ground. At the time of Lindgren's visit in 1898 the Black Jack-Trade Dollar vein extending into the Booneville property had been explored for "800 or 900 feet." The comment "that stoping has begun on the three levels nearly all along their extent, but the stopes are not yet high" (see Pls. XXIV and XXV) suggest the Booneville mine was not closed for lack of ore.

The country rock is described as "almost exclusively light-gray rhyolite, often banded, and of normal felsophyric character. In places where hard and flinty, it is referred to as 'quartzite' by the miners. Near the vein it contains scattered pyrite and is more or less softened. Small nests and veinlets of chlorite occasionally give the rock a greenish aspect."

Page 135 Booneville Mine

The following suggests the possibility of a branch vein not yet discovered: "The general direction of the drifts makes a slight angle with that of the Black Jack drifts, causing a belief by some that the vein forks at the point where intersected by the crosscut, and that one branch not yet opened extends somewhat westerly of the present lodes."

Lindgren described what he was able to observe of the vein, both on the surface and underground:

There are no good croppings except where shown by trenches, through the debris on the surface along the course of the vein shows much soft, altered rhyolite and fragments of ferruginous quartz.

The vein is generally from 4 to 12 feet wide, showing much ore, but of a relatively low grade. It consists of altered and crushed rhyolite filled with seams and stringers of granular quartz and valencianite (orthoclase). The walls are not always well defined.

The ore consists chiefly of finely divided argentite, sometimes visible as dark spots in the white quartz, but it also contains some gold, as does the Black Jack. A few cubes of pyrite were also noted in the quartz. Occasionally a little lamellar quartz, pseudomorphic after calcite or barite, appears. The quartz lamellae are then covered with small and beautiful crystals of valencianite. It is believed that the values are chiefly contained in the stringers and that the altered rhyolite itself is comparatively valueless. A bunch of high grade ore was found at the intersection of crosscut and vein. It is stated, and is probably a fact, that the whole distance developed by the drifts is in ore, though its value is such as to leave scarcely any profit at the present price of silver. [About fifty cents per ounce. Specimens of this ore should be collected.]

Page 135 Black Jack Mine

"History--The Black Jack mine is situated on the northern slope of Florida Mountain, and has for several years been one of the principal producers of the district."

Page 136 Black Jack Mine

As in the Booneville mine, much uncertainty exists regarding the extent of exploration and stoping. Lindgren reports the progress of development work as late as January 1899, but the Trade Dollar Company worked the mine at several levels until 1909 so the workings are considerably more extensive than those shown in PLS XXIV and XXV. At the time of Lindgren's visit the upper levels were abandoned and the mine was worked through two lower tunnels, the Black Jack (800 level) and the Idaho (1,200 level). A heavy flow of water into the shaft and intermediate levels below the 1,200 level closed the mine temporarily in 1899. Hopefully open pit operations carried into the upper levels will disclose whether subsequent Trade Dollar operations mined lower grade ores in the upper levels.

Pages 136-137 Black Jack Mine

Because Lindgren has provided information of wider significance in Chapter IV--Summary of Detailed Descriptions; and because fresh specimens from the lower levels of the Black Jack may not be recoverable, it is sufficient at this point to mention the desirability of having representative underground samples of country rock dikes and vein material wherever they can be found and the locations recorded. To whatever extent these objectives are achieved, the value of Lindgren's report will be enhanced.

The essential features of Florida Mountain geology appear in the Black Jack mine and are briefly described in the following explanation:

> In the granite--never in the rhyolite--the vein persistently follows a black dike of diobasic basalt a few feet wide, most strongly developed toward the south, and often pinching in the northern part of the mine. The workings have shown that the surface of the granite sloped northward at an angle of about 20, as indicated on PL. XXV and that on this old surface the rhyolite flow was poured out.
>
> The basalt dike mentioned formed the vent for a large flow of the same material preceding the rhyolite. This basalt was, however, poured out principally on the south side of the old hill on Trade Dollar ground, but a thin sheet covered the top of the hill and overflowed for some distance on the north side, as shown on the fourth and fifth levels of the Black Jack mine. The upper part of the mine is entirely in rhyolite, which, when fresh is a normal gray or brown felsophyric rock carrying small quartz crystals and entirely similar to that from the Booneville mine. The rhyolite occurring as dikes in granite is frequently of light gray color and almost flinty in texture. The Black Jack Crosscut is entirely in rhyolite. The Idaho Crosscut at first intersects a mass of granite, not cropping on the surface. It then enters the rhyolite shown on PL. XXIV at the left edge of the plate.

Although the main purpose of this summary is to focus attention on what seems to be important underground representative ore and rock specimens in the archaeological site, recovery of surface specimens should not be neglected. At the bottom of page 137 Lindgren indicates what may be found on the surface:

> The veins on Florida Mountain show very little in the way of surface croppings and can be traced only by means of cuts or tunnels. There is usually but little guartz, and the crumbling of the rock, somewhat altered over the whole mountain, soon masks the aspect of the vein. Where the vein is exposed by trenches, small streaks of quartz and valencianite with comb structure appear stained and encrusted by hematite and limonite and embedded in soft, brownish rhyolite, often with considerable masses of clay, resembling kaolin.

[At greater depth valencianite may have a different color, often milk-white (see page 167}.]

Pages 138-139 Black Jack Mine

The ore is described at the top of page 138 and again on page 166. An important feature of the gangue is valencianite, a rare form of orthoclase found in the vein whether it is enclosed in rhyolite, basalt, or granite. Page 138 also has a chart of values in the ore during the years 1893-1896. Vein structure is described at the bottom of page 138 and on page 139. The vein, averaging about 4 feet, is much wider in the rhyolite than in the granite and although the rhyolite section "has been rather extensively worked" ground above level 5 north of the granite contact is poor and the vein "practically lost for 300 feet above. On level 8, north of the granite contact, the rock is heavily mineralized, but poor. All of the altered rhyolite carries 2 or 3 ounces of silver." Specimens of this altered rhyolite should be recovered if possible.

Pages 140-147 The Trade Dollar and other veins on Florida Mountain

Descriptions of country rock and vein material in the Trade Dollar mine are not included

in this summary because open pit mining operations probably will not extend that far south. Similarly, except for the Empire State, the other seven veins on Florida Mountain are not involved. However, specimens should be recovered from the Empire State vein or any of the others that may be impacted.

CHAPTER IV

The Veins of Silver City and De Lamar (continued)

Summary of Detailed Descriptions

This chapter contains important conclusions drawn from Lindgren's observations of mineralogical data. Whether the specimens he collected would receive a different interpretation in the light of present or future knowledge will never be known with certainty unless samples of the kind he found are recovered. This attempt to point out some of the more significant interpretations and conclusions is no substitute for a careful study of the text, but it will, at least, further establish the need to collect the more important specimens. Lindgren worked with a collection of more than 300 items from De Lamar and Silver City mines.

(The following information consists of excerpts taken from Chapter IV. Introductory statements and comments are placed in brackets.)

Pages 160-161 Veins of Florida Mountain

Near the surface native gold was more abundant, probably on account of the oxidation of the ore above the water level. . . . The veins of Florida Mountain are of special interest, as they cut through granite as well as basalt and rhyolite. The Black Jack vein, the one most extensively developed in the Black Jack and the Trade Dollar mines, shows these relations will and is in other respects very remarkable. Considered as a whole it is a straight fissure, in strike as well as in dip. In rhyolite it is apt to be wider than in granite or basalt, and it may splinter into a number of stringers, which always, however, keep well together. In basalt it is narrow, and frequently closes down to a seam. In granite it lies on either or both sides of the basalt dike mentioned, [page 160 and page 137] which it closely follows. It is always sharply separated from the basalt by a clay gouge, but may be frozen to the granite. In basalt and granite it is a typical filled fissure, with frequent comb structure. In rhyolite it sometimes makes a composite vein and may be accompanied by some altered rhyolite sufficiently rich to be classed as ore. The throw [movement] along the fissure is clearly indicated. The hanging wall [along strike of the vein] has evidently moved downward and northward for 40 feet, about 40 from the horizontal, relatively to the foot wall, a normal fault having thus taken place. . . .

There is no material difference in its [ore] value and composition in basalt, rhyolite, and granite, but the quantity is greatest in the granite, [greatest in granite because not splintered into stringers] along the dike, less in the rhyolite, and least in the basalt. The presence of orthoclase {valencianite) as an important gangue mineral in the vein is a most unusual feature and should be especially emphasized. [well described on pages 166-167] It is equally abundant in granite, basalt, and rhyolite. The ore bodies are apparently very irregular, but have a tendency to form vertical bodies or bodies dipping slightly northward on the plane of the vein. The richest ore [of record, except probable richer ores near the surface] has thus far been found at the greatest depth attained from the surface.

[The descriptions above are repetitious, to a large extent, of information presented elsewhere in the report but are here combined and more succinctly stated.]

Pages 163-166 Ore Deposits in General

The country rock at De Lamar is rhyolite, on War Eagle Mountain granite, on Florida Mountain rhyolite, basalt, and granite. The rock's are altered by hydrothermal processes, but the course of the alteration is not that common in the case of the older vein systems of Idaho and many other parts of the West. Instead of the usual conversion to sericite and carbonates, we find a nearly total absence of carbonates and scarcity of sericite; and though there is some of it present in the altered rhyolite and a little in the granite, there is none in the basalt. The metasomatic [replacement] action does not take the same course in different rocks. The granite is but little altered, the rhyolite is extensively silicified, and the basalt is converted to aggregates of chlorite, epidote, and quartz, little of the later mineral being introduced in the rock. . . . The Black Jack vein and others on Florida Mountain and War Eagle Mountain are not pseudomorphic, but the absence of carbonates and the presence of valencianite, chlorite, and epidote in the gangue and in the altered rock proves that the mineralizing waters contained but little if any carbonates or carbon dioxide. . . .

The ores differ [De Lamar, War Eagle, and Florida Mountain] and yet show close relationship. Gold prevailed by value at De Lamar and War Eagle, silver at Florida Mountain; yet in all veins the silver exceeds the gold decidedly by weight. The mineral common to nearly all mines is argentite; pyrite is rare except in some altered rocks; marcasite occurs sparingly in the quartz at De Lamar and Florida Mountain. Galena and zinc blends are rare; cholcopyrite in small quantities is common on Florida and War Eagle mountains. The sulphides are always scant, but their value usually compensates for their small quantity. Native gold certainly occurs on many veins, probably on all.

The universal gangue is quartz, often with normal comb structure (War Eagle, Florida Mountain). But valencianite (a variety of orthoclase) occurs abundantly as gangue on the Black Jack vein, Florida Mountain; also on the Oro Fino and Cumberland veins, War Eagle Mountain; and on the Chautauqua vein, De Lamar. This rare gangue mineral is thus present in all the districts. Pseudomorphic quartz is characteristic of all the De Lamar veins and of the Oro Fino vein system. This means that the vein was originally composed of a wholly different gangue (and ore), probably calcite and borite all of which has been dissolved and carried away, quartz being deposited in its stead. The zone of oxidation extends only about 75 feet from the surface at Florida and War Eagle mountains, but several hundred feet at De Lamar.

The richest Ore shoots of the War Eagle Mountain have been found chiefly near the surface; the Poorman has not produced much below the Oro tunnel; the Oro Fino vein system appears to become barren at 1,000 feet, though good ore bodies extend to nearly that depth. . . . In the De Lamar mine the ore shoots. . .thus far [have] been found to extend only down to the tenth level. [about 700 feet] [On page 147 concerning the veins of War Eagle Mountain, Lindgren comments, "It is to be regretted that so few data are available regarding these important veins. . ."] In all these cases the vein itself continued strong and well defined. The Black Jack-Trade Dollar vein, on the contrary, contains its best ore shoots at the greatest depth attained from the surface, the richest stopes being found in the granite in the Trade Dollar mine, while the

rhyolite directly above this shoot did not contain much ore. Barren spots occur here also, where the vein continued good, but contains no pay. [By 1909 the Trade Dollar Company could not find good ore below the 1,600 level.]

Though differing much in detail, all of these deposits are doubtless closely related in origin and age. The veins of De Lamar and Florida Mountain are clearly post-Miocene; those of War Eagle are probably all of the same age, as shown by the Bishop and Oro Fino veins cutting rhyolite dikes and by the occurrence of valencianite on the Oro Fino vein system. Another point of interest is that the approximate depth at which they were formed is known. The surface of the latest rhyolite flow was, in all probability, but little above the summit of Florida Mountain and the highest hills to the south of De Lamar. Hence the deepest ore bodies in War Eagle were about 1,500 feet below the original surface, in Florida Mountain 2,000 feet below the same, and at De Lamar at perhaps a depth of 700 feet. At all places rich ore was also found near the old surface.

. . .[Black Jack-Trade Dollar vein] From the petrographer's standpoint one of the most interesting results is the direct connection of a long dike, constant dip and strike, with an overflow of basalt, a perfect proof of fissure eruption. The mining geologist will be interested in the fact that the old dike fissure has been reopened in the granite, extending up through basalt and rhyolite and filled in the manner of a typical fissure vein by gangue of guartz and valencianite, accompanied by rich silver sulphides. The evidence of purely aqueous deposition is incontrovertible, much as the composition of the gangue might tempt one to advocate the igneous origin of these deposits. [The "nearly total absence of carbonates and sericite," as noted earlier, would indicate igneous origin (cooling of molten magma}.] The evidence of principal deposition by the filling of cavities is equally strong, it being admitted that some of the ore in rhyolite is of metasomatic origin. The vein is narrow and often closing down to a seam, thus offering frequent support for the walls, and the evidence must silence the most zealous objector to the existence of open cavities along fissures. Finally, the similarity of vein matter (quartz and valencianite) and ore through the whole vein, in granite, basalt, and rhyolite, gives a strong and unqualified support to the theory of vein forming by ascending thermal waters, which carried up their loads of dissolved salts from below and deposited them in the fissure. Doubtless continuous dissolving and replacing processes were simultaneously active in the rock adjoining the fissure. An evidence of this is found in the introduction of chlorite into the rhyolite from the underlying basalt. But the bulk of the vein matter must have been derived from the depths.

Pages 166-169 Mineralogy of the Veins

[In these pages Lindgren lists the various minerals found, indicates the quantities present in different veins, and describes in great detail rare and unusual occurrences. Fresh specimens should be obtained if at all possible. Valencianite, not as rare in veins, perhaps, as Lindgren believed in 1899, is extensive in Florida Mountain veins and has received much attention.]

Orthoclase var. valencianite. Orthoclase is very uncommon in mineral veins as an integral part of the gangue or filling, and its abundant occurrence as such at Silver City is therefore of special interest. . . . Breithaupt described, without any notes as to its occurrence, an orthoclase of adularia habit from the Valenciana silver mine, Mexico, State of Guanajuato. It seems that this interesting occurrence has until now escaped the eyes of mining geologists, although well known to mineral collectors all over the world. . . . To prevent confusion with

orthoclase from the wall rocks and from other occurrences, it has been thought advisable to use Breithaupt's old name of valencianite, restricting it to orthoclase of adularia habit occurring as gangue mineral in fissure veins.

The vein on which the Booneville, Black Jack, and Trade Dollar mines are working contains, in the rhyolite and granite as well as in the basalt, abundant valencianite as large milk-white grains with typical cleavage. The mineral contains inclusions of chalcopyrite and argentite, [gold in chalcopyrite] and sometimes also thin lamellae of the former mineral deposited parallel to the best cleavage. Crusts of projecting crystals of valencianite, with more or less broken and curved faces, often coat the walls of the vein. (PL. XXIX). . . . In the Booneville mine small transparent crystals are also found coating a lamellar quartz, itself a pseudomorph after calcite or barite. All these occurrences demonstrate beyond doubt the aqueous origin of the mineral. (The temperature at which valencianite was formed in the vein can hardly have much exceeded +100m. See page 165.)

Pages 169-174 Structures of the Ores

De Lamar

[The structure of De Lamar ore is included here because De Lamar pseudomorphic quartz described at length on page 170 and illustrated on Pls. XXVIII and XXX is also found in some veins on War Eagle Mountain and to a lesser extent in the Booneville mine on Florida Mountain. Clearly samples of pseudomorphic laminated quartz (lamellar quartz) from De Lamar should be preserved to compare with similar quartz from other mines. Lindgren comments, "We can only surmise what the character of the ore in the vein was before the pseudomorphic action, the completeness and extent of which is a most remarkable phenomenon."]

Florida Mountain

The ores of the Florida Mountain are not, as a rule, pseudomorphic in origin. The veins are narrow, rarely 1 feet, more commonly 6 inches. The gangue consists of quartz and valencianite, ordinarily in granular mixture, or of quartz alone. In the narrower veins, such as Empire, also in Black Jack and Trade Dollar, and in the Morning Star, crustifications and typical examples of comb quartz are very common. There may be two superimposed generations of comb quartz separated by a band of silver sulphides, or the latter may be deposited directly on the walls as a narrow, black streak. . . . Evidence of pseudomorphic action seldom appears. In the Booneville mine the quartz has occasionally the same "chopped" character noted from De Lamar, and some beautiful pseudomorphs of lamellar quartz are completely coated by white, often perfect, crystals of valencianite. The original mineral is here, probably barite, which is not now found in the Black Jack vein. In conclusion, it may be said that there is no reason to doubt that the largest part of the ore from the Booneville-Black Jack-Trade Dollar vein represents typical filling of open cavities.

War Eagle Mountain

[Since vein structures on War Eagle Mountain vary considerably, containing nearly all of the kinds of ore found at De Lamar and Florida Mountain, they will not be described in this summary. But again it is desirable to have specimens. Sections of Silver City and De Lamar ores are shown in Pl. XXXI.]

Page 174 Hydrothermal Alteration of Granite

The granite adjoining the veins of Silver City, Florida Mountain, and War Eagle

Mountain is, as a rule, very little altered, much less so than the basalt and rhyolite. Almost entirely fresh rock, containing only a few minute fibers of sericite in the orthoclase, or showing an incipient alteration of biotite to chlorite, very often adjoins the vein filling. [sample needed]. . . . Along the seams of the crushed granite, crusts of well-crystallized valencianite are often deposited, but rarely accompanied by any sulphides.

The slight degree of alteration to which the granite has been subjected appears very remarkable when it is considered how intense the metasomatic changes of the same rock are along most of the gold and silver veins north of Snake River. . . .

Page 174 Hydrothermal Alteration of Basalt

The basalt is, as a rule, a very fresh rock, which yields only slowly to the oxidizing influences of surface waters. Wherever weathered it is changed to dark-brown clayey soils. It is only when traversed by ore-bearing veins, as on the south slopes of Florida Mountain, it exhibits any far-reaching alteration. Even here the alteration is capricious in its extent. As a rule the altered zone is not wide, and comparatively fresh rock may be close to the vein. On the other hand, irregular areas some distance from the veins may have been greatly altered by penetrating solutions. The question is largely one of the degree of permeability of the rock. [by fracturing?] The 500 foot crosscut from the Trade Dollar vein westward across the Sierra Nevada and Alpine veins traverses for most of the distance a bluish, altered basalt containing pyrite in small cubes. The basalt dike in granite, which the Black Jack-Trade Dollar vein follows so persistently, is less altered than would be expected, this being possibly due to the continuous clay gouge by which it is bordered on both sides. It is, however, generally soft and chloritic, and contains some pyrite. The altered basalt near or in the vein is never, as far as known, rich enough to be considered ore. It may contain up to 1/20 ounce gold and 4 ounces silver per ton. The pyrite in it is never rich enough to pay for concentration. . . . In more advanced stages the rock becomes bluish green or yellowish green, the latter color due to the development of epidote. . . . In their extreme state of alteration the basalt and the rhyolite are often difficult to separate [samples needed]. . . . Occasionally epidote develops very abundantly, apparently from the chlorite by addition of lime from the feldspars. . . . Silicification, so common in the rhyolite, has not been noted in the basalt.

. . . This course of alteration is radically different from that which basic rocks have suffered near the gold quartz veins of California and that shown by lamprophyric dikes and diorites from Idaho veins thus far examined. In these, all ferromagnesian silicates are destroyed and sericite and carbons are formed abundantly, while in the case here described the latter two minerals are almost entirely absent. The conclusion is inevitable that the waters were very poor in carbon dioxide. This chloritic alteration would seem to be more common in tertiary gold silver veins connected with volcanic rocks than in those of greater age. [Presumably those in granite north of Snake River are of greater age.]

[Page 176 has an analysis of the basalt dike following the vein at the eleventh level of the Black Jack mine.]

Pages 177-186 Hydrothermal Alteration of Rhyolite

General Remarks

[While alteration of rhyolite was much more extensive than alteration of granite or basalt, the processes were also more complex. Understandably, Lindgren dealt mainly with occurrences

at De Lamar where the mine was entirely in rhyolite. For these reasons and because this summary is primarily concerned with Florida Mountain only excerpts of wider application or significance are included.]

The rhyolites of De Lamar and Florida Mountain are much altered, and the metasomatic change is not confined to the immediate vicinity of the veins, but affects the rocks for many hundred feet from the fissures. At both places the normal process is a silicification. . . . The rock often preserves its structure and has a deceptively fresh appearance. The only other minerals of importance found are sericite and pyrite, at Florida Mountain, and sericite and marcasite at De Lamar. This silicification is most intense at De Lamar; less so on Florida Mountain. . . . At Florida Mountain, near the basalt, the rhyolite is not distinctly silicified, but contains much pyrite and a chloritic or serpentinoid mineral. . . .

Pages 184-186 Florida Mountain

The thermal alteration of the rhyolite of Florida Mountain is strongly marked, and in some cases goes so far as to make identification very difficult. The alteration presents two differing phases.

The first and by far most common alteration involves a silicification. This has affected the rhyolite throughout nearly its entire mass. It shows in the surface rocks of Florida Mountain, in the specimens collected in the Booneville and Black Jack levels in rhyolite, in the dikes in granite in the Black Jack, and in the dikes of War Eagle Mountain. The surface rocks are of a white or grayish and dull, earthy aspect, sometimes showing microfluidal structure and nearly always small quartz phenocrysts. The underground specimens are light gray or brown, often flinty, and apparently very fresh. Frequently they contain finely distributed pyrite. Under the microscope the quartz phenocrysts are sharply defined, but nearly always surrounded by an aureole of secondary quartz of parallel orientation, sometimes extending irregularly into the groundmass for some little distance. . . . Small cubes of pyrite--never marcasite--are scattered through the groundmass, chiefly in the secondary quartz. Epidote is not uncommon in the feldspars or in the small quartz veinlets; it must be considered as introduced from the basalt. . . . The groundmass is strongly silicified. . . . it seems probable that many if not most of these nests and vugs represent dissolved rock material, simultaneously or afterwards filled with silica. Valencianite was repeatedly noted in veinlets in rhyolite from the Booneville mine. The groundmass itself is recrystallized, usually converted to a microcrystalline aggregate of quartz and shreds of sericite.

. . . A silica determination was made by Dr. W. N. Stokes of specimen 208, Silver City collection, from Black Jack Mine, level 12, dike [rhyolite] in hanging of vein 300 feet south of main crosscut. It yielded 77.6 per cent SiO_2, which indicates an apparent addition of some percent of silica.

The second phase of alteration occurs near the contacts of rhyolite and basalt in the Black Jack, and still more in the Trade Dollar mine. Near the contacts the rocks are here most difficult to separate, especially in tunnels 2 and 3 of the Trade Dollar Mine. The process of alteration is not a silicification, though the rocks always contain much secondary silica, but rather a chloritization, the material evidently being derived from the underlying basalt. . . . Wherever phenocrysts of quartz or sanidine remain, the diagnosis is easy, but these have frequently disappeared and the rock, as shown under the microscope, is made up of a very fine groundmass,

probably largely quartz, intimately suffused and mixed with fibers of a brownish material, perhaps serpentine or green aggregates of chlorite. . . .

[On page 186 Lindgren mentions the occurrence of quartz crystals penetrating a strongly silicified rhyolite foot wall along a narrow fissure with a less silicified basalt hanging wall. Quartz crystals also have grown outward into the upper wall.]; the growth began from the plane and penetrated by metasomatic processes into the upper wall, the altered silicious character of which facilitated the assimilation. These facts show that, under favorable circumstances, veins with comb quartz may occasionally result from metasomatic action. While this is most interesting, it would be entirely false to draw the conclusion that this is the normal or common mode of formation.

Surface Features of the Archaeological site

The Underground Site

Open pit operations on Florida Mountain will expose early workings down to whatever depth is profitable; laterally as far north as the Humboldt shaft; and south, perhaps to the end of the Black Jack claim. Although adit tunnels are now generally closed by surface sloughing much of the underground excavations should be accessible because workings along steeply dipping veins tend to remain open except where timbers decay in stope waste fillings. since upper levels were not open to Lindgren, for the most part, and Trade Dollar maps only show lower operations, the nature and extent of workings nearer the surface is largely unknown. Therefore, much early Florida Mountain mining history will be lost unless some record of exposures is made during open pit operations.

Mine Workings

The upper mine workings may not contain all of the adits intermediate levels, drifts, crosscuts, shafts, raises, and winzes usually found in a large mine, but they should have several thousand feet of tunnel and numerous stopes where ore has been extracted. Simply knowing the extent of the workings is important because all of the work was done with hand steel and some, perhaps, with black powder. Until the invention of dynamite in 1867 and machine drills a few years later, black powder and hand steel were the only means of breaking hard rock. Although black powder exerts a great heaving and propulsive force, the shattering force is considerably less than that of dynamite. Consequently, drill holes for black powder were larger. Because of the expense of providing power for machine drills, small operators often continued to use lighter hand steel with dynamite until rising costs in the 1940's began to discourage underground mining. While the expense of installing and operating machines was substantial, miners could break at least three times more rock than men working with light hand steel and dynamite, and perhaps four times that of miners using heavy steel and black powder. Hence, determining the method of drilling determines the rate of excavation. Unless old drills are found, evidence of hand steel work is usually the smaller tunnels, 4 feet x 6 feet compared to 5 feet x 7 feet drilled with machines.

Hand Steel Drilling

Hand steel drilling was performed either by a "double jacking" team--one man turning the steel and the other striking with an eight pound sledge, or by "single jacking"--a man turning the steel with one hand and striking it with a four pound hammer in the other hand. Double jacking was necessary in drilling the large diameter holes required for black powder blasting because the wider cutting edge and heavier drill steel was ineffectual under four pound hammer

blows. After the introduction of dynamite single jacking steel, never larger than 7/8 inches in diameter, generally supplanted heavier steel with cutting edges wider than 1 1/8 inches used in double jacking. Little is known regarding the actual size of black powder holes because few of the old drills are found anywhere today. Large drills discovered underground will date workings more accurately since smaller drills may have been brought in at a later date to resume work begun with large drills.

Mining Methods

If open pit mining does not render openings too hazardous to enter, much should be learned about the early technology. Although timbers may have rotted, timber hitches--or the lack of them--in solid rock often indicate the method of mining: they provide clues as to shrinkage stoping, underhand stoping, stulls and headboards, cut and fill with butt caps, square sets, or cribbing where no timber hitches are found. Values found in rock not mined or in waste rock used for stope filling will indicate the richness and size of deposits that could be mined and milled profitably in the early days. And, of course, representative samples of ore and country rock should be recovered.

Equipment

The underground archaeological site may contain a great variety of artifacts still recognizable enough to shed much light on the older Florida Mountain mining technology--especially its limitations. Working in candlelight as late as the second decade of the 20th century, miners lost numerous small tools and pieces of equipment. Larger items such as mine cars and rails were sometimes left underground for a number of reasons: they were worn out; lost under or behind cave-ins; and sometimes abandoned either because no longer needed or left for uncertain future use. After more than a century many items will have disintegrated, yet under favorable conditions even wooden objects retain the original shape. Mine timbers continually wet will last indefinitely. some of the larger equipment that might be found underground are mine cars, wheelbarrows, hoist buckets, skips, rails, cable, and windlasses. Depending upon the circumstances, any of these items may have special significance. For example, a windlass definitely indicates a winze or shaft sunk below the level. The design of heavy equipment may be useful in dating an excavation, and capacity or limitations may suggest the kind of work undertaken. The conclusions drawn from finding a half ton capacity mine car of wood construction on strap iron covered wooden rails compared to a three quarter ton steel car on steel rails is quite apparent. On Florida Mountain, miners probably drove the Black Jack Tunnel (800 level) with machine drills and they may have used them for stoping above that level. Anything indicating use of compressed air, such as pipe or high pressure hose would establish evidence of machine drilling. If open pit mining should reach the 800 level, different styles of machine drill bits found in the Black Jack Mine would indicate work not earlier than introduction of the particular style of bit discovered. Detachable bits found in the mine would prove that it had been reopened at some date after 1930.

Hand Tools and Small Artifacts

Extensive underground operations require ore chute construction, more elaborate forms of timbering, and various mechanical devices--all involving the use of numerous small tools and fittings. The following lists contain items often used underground in both small and large mines. The kinds and quantities of artifacts point to the nature of mining operations carried on.

Smaller Equipment and Tools Used Underground

Timber framing tools
- Single bit axes
- Log dogs to hold timbers for framing
- Framing saws (3 to 4 foot crosscut)
- Hanging rods for shaft timbering
- Plumb bobs

Haulage equipment accessories
- Rail spikes
- Fish plates (rail connecting plates)
- Fish plate nuts and bolts
- Spirit levels
- Mine car parts--beds, levers, rods, wheels, etc.
- Wooden mine car beds with iron reinforcement and parts
- Mule harness parts
- Mule shoes
- Single trees and fittings

Machine drill steel

Machine drill steel is easily distinguished from hand steel by shank to fit the drill chuck instead of a battered end from hand hammering.

- Plain chisel-bit steel until 1897
- Side flushing port in chisel bit for wet drilling invented by J. G. Leyner in 1897 was used until about 1907.
- Star-bit steel with center flushing hole continued in use until 1930 when detachable star bits replaced the conventional solid forged drill bits.

Machine drill and accessories
- Screw columns and arms for mounting drills
- Tripod drill mountings
- Chuck wrenches
- Air and water hose valves and fittings

Hand tools (general use)
- Picks--drifting, sampling
- Shovels--round point, square point (used on turn sheets)
- Bars--crow, pinch, wrecking
- Wrenches--pipe, adjustable, open end, etc.
- Hammers--claw, ball peen
- Carpenter's--squares, saws
- Brace and bits
- Wood chisels
- Measuring rules
- Punches
- Screw jacks
- Sledges and mauls
- Cold chisels

Hand drilling tools

Heavy drill steel--1 inch and larger to drill holes for black powder
Light drill steel--7/8 and smaller to drill holes for dynamite
Drill hole cleaning spoons
Augers for boring holes in soft rock or clay
Double jacks (8 to 10 pound sledge hammers) for use with heavy drill steel
Single jacks (3 ½ to 5 ½ pound hammers) for use with light drill steel

Blasting equipment and containers
- Blasting cap (detonators) crimpers
- Pocket knife for splitting fuse
- Fuse
- Blasting cap boxes
- Black powder canisters and kegs
- Dynamite boxes

Illumination
- Candle sticks (candle holders)
- Candle lanterns for use in strong drafts
- Candles
- Carbide lamps and carbide containers

Miscellaneous supplies and equipment
- Pulleys
- Clevises and shackles
- Cable clamps
- Turnbuckles
- Pip fittings and valves
- Square cut spikes and nails
- Nuts, bolts, washers
- Drift pins
- Lag screws
- Lunch pails and thermos bottles
- Rubber boots
- Leather boots and gloves

[1]Lindgren, Waldemar, "The Gold and Silver Veins of Silver City, De Lamar and other mining districts in Idaho," *Twentieth Annual Report of the United States Geological Survey* (Washington, 1900) 3:67-189.

(This information has not been edited.)