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General Report of the Geology

of

The Copper Basin Property of the

Copper Canyon Mining Co.

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I N D E X

General Report on the Geology of Copper Basin.

The larger part of the summer of 1919 was spent in making the topographical and geological map of the Copper Basin property of the Copper Canyon Mining Co. The finished map on a scale of 300 feet to the inch covers about nine and a half square miles. In addition the geology of the major openings on the property was mapped in detail, a study made of the possibilities of future water supply and various minor examinations made of nearby properties of possible future value to the company. The following is a general summary of the results attained and such recomendations as are justified by our present knowledge.

The rocks of this area can be subdivided into three natural groups; the sedimentary rocks, chiefly micaceous sandstone, quartzite shales and limestones; the intrusive igneous rocks, a series of quartz monzonite dikes; and the extrusive igneous rocks, a flow of rhyolite covering Elephant Head ridge and adjacent hills in the eastern corner of the property. In addition the areas so deeply covered with the surface gravels that the geological features of the bed rock were obscured, was mapped as alluvium.

Sedimentary Rocks. The sedimentary rocks belong to a thick series comprising the bulk of Battle Mountain. A general section as given by J.M.Hill in Bulletin 594 U.S.G.S. is as follows:

Thin and thick medium gray limestones	2000 feet,
Medium and fine grained, red brown conglomerate with red and yellow micaceous sandstone at top	1500 feet,
Vitrous white quartzite, weathers in red and brown colors	1000 feet,
Black shales with red sandstone at top	thickness unknown.

As the general structure of the mountain mass is that of an eroded dome the younger rocks appear on the flanks. The area controlled by the company lies on the north eastern slope of the mountain and the rocks exposed belong only to

the two upper groups of the general section.

In the area recently mapped the limestone occurs east of a line running nearly due south from the Elvira claim though the Blue Bird. An attempt was made to find and distinguish a line of demarcation between the limestone and underlying sandstone, but as they gradually merged though the 300 -400 foot transition zone of calcareous sandstone and shales and had been locally altered with the varying intensity no mapable boundary could be recognised.

The limestone is typically massive, dark grey to drab in color, and with little evidence of bedding. Occasionally thin seams of pure white calcite occur crossing at various angles. In the hill just beyond the north end of the Dipper claim, the limestone contains numerous lenses of chert up to 6 inches in width. For the most part, however, the limestone weathers into a yellow shaly fragment that resembles a calcareous shale. A tunnel at the north end of the Copper Prize No.1 claim is driven northerly into a hill whose surface is completely covered with yellow shaly fragments. In the first 20 feet of the tunnel the gradual change from the yellow shaly phase of the limestone to the massive drab phase may be observed. Another example of the gradation between the two phases may be seen at the ridge north of the Surprise Tunnel. The west slope of the ridge is formed by the massive drab colored limestone, while the east slope is covered with the yellow shaly phase. On this hill just over the crest of the ridge, typical fossils of Pennsylvanian age (the coal forming period of eastern U.S.) occur poorly preserved in the shaly limestone.

The sandstone underlying the limestone is typically dark brown and micaceous when fresh and unaltered, and cover the area west of the line joining the Elvira and Blue Bird claims. As a rule the individual beds are from 1 to 3 feet in thickness and frequently change from a course conglomerate to a fine grained shaly sandstone. At the top the shaly beds predominate and become more and more calcareous until the merge with the massive limestone above.

The sedimentary rocks dip gently to the east with a strike of a few degrees east of notth. In the ore bearing area, sheeting has developed in sympathy with the major faulting of the area that so closely simulates bedding that it is easily mistaken for bedding planes. This sheeting dips east about 45 degrees and were it not for the observations made ourside the mineralized zone would be considered as the dip of the sedimentary rocks. The true dip is about 20 degrees however, and as the section is duplicated to some extent by the north and south faults, only about 1500 feet of the sedimentary column is represent on the peoperty.

Quartz monzonite porphyry. Intruded into the sedimentary rocks are numerous dikes of irregular masses of quartz monzonite porphyry. In the western half of the area the dikes have a rather constant strike of north 10 degrees west, while in the eastern half they run nearly east and west. When fresh, the porphyry is dark green in color with large large crystals of quartz and feldspar imbedded in a finely crystalline grandmass of feldspar, hornblende, biotite and quartz. There is considerable variation in the relative amounts of the different minerals, not only in the different dikes, but in the same dike from place toplace. At one point the feldspars may be mainly orthoclase, while elsewhere the pagioclase feldspar predominate. Further the biotite may be dominant at one place and be entirely lacking a short distance away. As the classification of the igneous rocks is based upon their mineralogical composition, hand specimens collected at different points may be classified as granite, quartz diurite or quartz monzonite and the varieties as biotite or hornblende depending on which combinition of minerals forms the higher proportions of the different samples. As all of the minerals usually occur with the two classes of feldspars, approximately in equal proportions, the dikes are correctly determined as quartz monzonite porphyry even though locally they may not conform strickly to this classification.

The dikes vary in width from a few feet to over 200 feet in exceptional instances. As a rule the dikes in the western half are about 100 feet wide while those in the eastern half are from 20 to 40 feet in thickness.

Owing to the lack of underground development the general dip of the dikes is unknown, but such as have been cut are usually from 20 to 60 degrees.

During the earlier stages in the work it was thought possible to distinguish between two types of dikes, the earlier, much altered and characterized by irregular boundaries, the rounded and crushed crystals of quartz; occasional small rectangular masses of kaolin apparently altered feldspar and abundant sericite; and the other or latter porphyry that contained large crystals of orthoclase with well defined walls and coarse biotite or hornblende. Eventually it was found that the early porphyry was in part offshoots and spurs from the dikes proper and in part was a metamorphic phase of the sedimentary rocks. As the copper ores were associated with both types of porphyry and it was definately proven that they were contemporaneous, this hypothesis had to be abandoned.

North of the Vail group are two large areas of porphyry roughly circular in outline and approximately 2000 feet in diameter. These seem to be the nucleus from which the dikes radiate. Here all gradations between the different phases of the porphyry may be observed. The western mass is darker colored and fresher. Both masses have numerous grains and bunches of quartz with a granular sugary texture and segregations of dark fine grained diorite.

In general the phenocrysts of the porphyry are large rounded crystals of quartz, rectangular crystals of orthoclase, lath shaped crystals of plagioclase feldspar, and crystals of biotite and hornblende in varying proportions. The groundmass in finely crystaline and composed of the same minerals. The eastern mass has a lighter colored groundmass on account of a partial alteration of feldspar to sericite, a fine grained variety of muscovite or white mica. Seams and specks of limonite stain the porphyry light yellow in places. A similar triangular mass of the porphyry occurs on the top of the high hill just north of the Contention Shaft.

The effect of the intrusion of the porphyry on the sedimentary rocks varies greatly from point to point depending in part on the irregularities in the distribution and compositions of the emanations of the cooling

porphyry masses, and in part to the variation, both physical and chemical, in the sedimentary rocks themselves. The limeston displays the greater variety of phases At times the lime was simply replaced by the silicia producing a very fine textured, hard, porcelaneous, light grey rock. Again a light yellow or brown garnet was substituted forming a gard fine textered light yellowish or greenish rock, or the garned crystals may be of considerable size giving a granular textre. Further epidote may have been developed giving the various shades of green from a bright yellowish green shade to a dull dark green of the formation of the white fibrous minerals, tremolite and wallastonite changed the rock to a matted mass of dirty white or light cream color. At times the limestone has been simply recrystalized into a mass of very coarsely crystaline calcite.

The Elvira tunnel offers an excellent opportunity to study the different phases of metamorphism of the limestone. Here the different phases may be found at times within an area of a square foot, so rapid is the change. The face of the tunnel is in a border phase of the porphyry which feats as a large lenticulat mass on the dike proper. This mass is a dark greenish, coarsely crystaline, even grained rock composed of actinotite, biotite, epidote, magnetite, and plagioclase feldspar. Most of the masses of actinotite and epidote has the outline of hornblende indicating the former presence of the later and it is evident that the rock was formally the dioritic phase of the porphyry. Such border zones, while not common, have been recognized in many instances in other localities and may be due either to a local change in the composition of the molten rock material as certain minerals crystallize out more rapidly than the others or, though fusion and assimilation of a portion of the invaded limestones. A network of minute veinlets and desseminated grains of iron sulphide pyrrhottite and pyrite, cut the diorite usually with a narrow border of bleached and altered rock on either side. These represent the final product of the solidification of the rock mass.

The dikes in the sandstones and shales has similarly produced several different types of alteration. Where the sandstones were originally nearly pure quartz the introduction of additional silica has changed them to white, hard, and tough

quartzites. When iron was present in considerable quantities the sedimentary rock was changed to a felted mass of the green mica, chlorite, containing masses individual grains of pyrite. Frequently such silica as entered the rock crystalized in local spots as large crystals of quartz and gave the rock a porphyroid appearance that makes it very difficult if not impossible at times to distinguish it from the true porphyry.

These areas of pseudo-porphyry occur almost exclusively as border zones along true dikes. Along the northern border of the property in the Boyds- Bray group nemerous instances were noted where as the dikes disappeared under the ridge the border phase continued on for 20 to 150 feet. In the Sweet Marie the bulk of the ore developed is found either in the "pseudo-porphryr" or the related chlorite rocks. Yet some of the occurances of similar rock encountered here have the form of dikes and were apparently spurs or offshoots from the porphyry dike of unquestioned origin. Eventually the only criteria that remained valid in distinguishing between the oxidized porphyries and these "pseudo-porphyries" were the dikelike form and the presence of rectangular masses of kaolin retaining the crystalsoutline of feldspar from which they were derived. The dike in the Chase Shaft and the small dike in the raise from the south 2 west cross cut in the Sweet Marie are examples of this type.

There are a few occurances of extensive areas of the "pseudo-porphyry" that apparently have had several dikes involved in their formation. One of these extends as a zone begining on the Dean Lang group running east along the ridge and crossing Long Creek continues to the Sweet Marie. One dike strikes parallel to the zone east from the Vail Tunnel and intersecting the zone just west of the Chase Shaft is the dike that is cut by the north drifr on the 120 ' level of the Sweet Marie. The dike cut in the Raven tunnel crossed the zone nearly at right angles and several other dikes cross obliquely to the west.

On top of the high ridge extending fo

north of the June and Crown Point claims are two or three areas of the "pseudo-porphyry" but slightly altered. Here the intimate relationship between the partially replaced sediments and several small fresh dikes of monzonite can be readily ovserved.

Rhyolite. Extending over a considerable area east of the boundaries of the original group of claims is a flow of rhyolite from 150 to 300 feet thick resting upon the older sedimentary rocks and dikes. At the base of the flow the underlying rocks have been baked and their color changed to a deep brick red to a depth of two to six feet. It is needless to say that this zone is without economic interest.

The rhyolite at the base is light colored and more or less tuffaceous or ashy for the lower 20 feet. Above this it is glassy and black with small rounded blebs of obsidian included among the crystals of quartz, orthoclase, and biotite. The greater part of the flow, however is the rhyolite, which is lavender colored, felsitic or stony and massive. The rhyolite is evidently much later than the period of primary mineralization and is but a barren cap rock or malapais covering the limestones and dikes below.

Faults. Numerous faults occur in the area and gardly a saddle exists but has evidence of from one to several fractures crossing it. The attempt to prove their continuity in the absence of underground developmene was disappointing. Only where a dike or particular sedimentary bed could be followed was it possible to note the displacements. Only those that could be followed with some degree of confidence were placed upon the map. but it should be remembered that they form but a small minority of these present. From such evidence as could be gathered it may be said in general that there are a multitude of small faults and fissures, usually roughly parallel and striking within a few degrees of north or east. Such displacements as could be observed are small and cause but slight offsets. While the faults dip at all angles the majority were inclined between 40 and 60 degrees. Their chief function has been to conduct the surface solutions and concentrate the secondary ores.

Primary Ores. The relationship between the dikes and the primary ore is a very intimate one. As has been shown in the previous work the original copper bearing mineral is pyrite enclosing varying amounts of chalcopyrite in minute grains. The pyrite occurs as irregular masses in the chlorite rock, as deseminated grains in the quartzite, "pseudo-porphyry" and altered shales, and in veins and stringers or quartz. Not only does the copper content vary irregularly from a trace to one per cent, but the relative abundance of pyrite greatly changes. As a result although some pyrite occurs practically along all the dikes it is only in the spots where it has segregated that the ore shoots are found. Up to the present in the few places where the primary ores have been encountered they have not been up to commercial grade, but it is not at all unlikly as the development of the secondary ores continues that such a shoot may be discovered. At present there are no clews available to predict their location with any degree of certainty.

The cupriferous pyrite was introduced by solutions resulting from the solidification of the molten rock masses that formed the dikes. This is indicated by the very close relationship of the ores to the dikes and the occurance of the sulphides in the dikes themselves. As at times the pyrite is in veinlets in the porphyry predicating the solidification of the greater part of the dikes before the sulphides were deposited, the ore bearing solutions must have been active towards the close of the igneous period.

This is in harmony with present knowledge of the laws governing the formation of dikes. The molten mass whenfirst intruded is a solution containing not only the minerals now found in the dikes, but varying amounts of water, fluorine, boron, iron, copper, sulphur and other metals. As this solution cools it does not reach the point of saturation of all the minerals contained in it at the same time, but begins to separate one after another according to the amount and fussibility of the different minerals present. As a result the composition of the solution constantly changes becoming progressively poorer in the minerals crystallizing out and richer in those retained in solution.

Usually the sulphides and water are among the last to separate and the final fraction of the magma to solidify is largely composed of these. While still at a comparatively high temperature, approximately 300 to 400 degrees C., at first in the form of a gaseous solution, but later as a liquid it penetrates the pores and cracks of both dikes and wall rocks and deposits the ores, in part as a replacement of the minerals composing the original rocks and in part in the open fissures and spaces.

As the wall rocks vary from point to point both in porosity and composition the amount of pyrite deposited differs greatly. Where the rocks were open and susceptible to replacement the solutions had free access and the primary oreshoots were formed; where the rocks were tight and relatively insoluble the amount of pyrite is small and the ore lean. Further thr relative amount of chalcopyrite contained in the pyrite differs from place to place, so that while more of less mineralization has taken place along the dikes, the bodies of higher grade primary ore are more or less local.

Of the different metamorphic phases of the sandstones and shales the chlorite rock seems to have been the most susceptible to mineralization. In this type the cupriferous pyrite occurs in the larger and more frequent masses. The soft highly altered shales and fine grained sandstones come next in value while the hard tight siliceous quartzites are usually practically barren.

The metamorphosed limestones, while mineralized to some extent, so far have proven to be of rather low grade. This is probably due no so much to the relatively slight amount of primary mineralisation, but that the different phases are all the more or less hard and massive hindering to a large degree the secondary concentration of the copper that is mainly responsible for the higher grade of the ore in the clastic sediments.

Secondary Ore. It has been estimated that the depth necessary for dikes and Primary above
ores of ~~this~~ type to form is at least one half mile below the surface. During the millions of years that have elapsed since the primary ores deposits were formed the surface agencies have been actively removing the covering rocks, and finally

brought the ore bodies within reach of the ground water. This carrying oxygen reacted with the sulphides, desolving the copper as copper sulphate. As the solution resulting penetrated the deeper bodies of cupriferous pyrite the copper replaced the iron and formed the copper sulphide, chalcocite. This raised the copper content of the primary ores to the point where they have become commercially valuable.

The factors governing the reconsentration of the copper ore are the relative amount and value of the primary sulphides; the porpsity of the rocks; the amounts and extent of the fissuring; the presence of impervious barriers, such as, massive, hard quartzite or clay filled faults that serve to control and direct the downward path of surface waters.

It is obvious that hwere the primary ores are most abundant that the secondary enrichment will be greater, other factors being equal. If, however, the rocks surrounding them are tight and impervious to the circulating waters they will be but slightly enriched and must depend largely on their original copper content for their values. Either the rock in which they are contained must be coarse grained and open pored, as is the bed of sandstone, but on the 150 foot level of the Chase Shaft in the number 2 west drift about 50 feet from the station, or subsequent fissuring must have opened the rock to the passage of the copper bearing solutions coming from the surface.

Occasionally as in the case of the main fault encountered at the east in the 120 foot level of the Sweet Marie Shaft an impervious layer of clay gouge had acted as a dam forcing the surface solutions to travel through the rocks of the hanging wall.

Of the different factios the presence of the primary ore shoots and the fissuring seem to be more important.

Surface Indications. The problem of greatest importance at the present stage if development is the determination of the surface conditions that indicate with a fair degree of accuracy the location of the bodies of commercial ores.

The work already accomplished at the Sweet Marie and the Chase Shafts have conclusively demonstrated that such bodies are intimately associated with the dikes. Consquently the location of all the dikes on the property known at present has been accurately plotted on the general topographical and geological map just finished.

Unfortunately the mere presence of a dike does not always mean a body of commercial ore. Whenever such a body exists the dike and adjoutning wall rocks have been extensively altered and softened by the solutions, the oxidation of the pyrite has left behind spots and stains of iron rust or limonite and occassional co copper stains are present. Consquently all of the area where the dikes and rocks are fresh and retain their original minerals, may be eliminated.

As the copper content of the pyrite varies widely from point to point these areas with the higher grade ore should be separated from deposits below commercial grade at present. This is much more difficult, but in general where the pyrite is low grade the iron stained outcrop or gossan is very heavy and dair colored, while the higher percentage of copper will be found under the lighter yellower gossan, especially when accompanied by bright reddish spots and streaks indicating a trace of copper oxide, cuprite. It is logical to assume that where the larger bodies of carbonate ores are found that the enrichment of the underlying sulfides are greater. This has been demonstrated in the Chase and Sweet Marie Shafts, however, it will be found that the bodies of sulfide ore are situated more closely to the dikes that are the carbonate ores.

The effect of the composition of the sedimentary rocks seems to have played a considerable roll in determining the location of the bodies of sulphide ore. In the area of calcareous shales and limestones lying east of the Chase Shaft the easily replaced country rock seem to have located the ore bodies in the walls of the dikes rather than in the dikes themselves. On the other hand in the western area, where the sandstones and quartzites dominate, the sulpnide ore seem to be largely confined to the dikes. The amount of development work in thisparticulat

area is not sufficient at present to demonstrate this, but much as has been done, especially in the Vail Shaft, certainly suggest that such is the case.

The amount of fissuring that has taken place is also an important factor and should be taken into consideration. The areas that give the greater promise of underlying ore bodies are located along and in dikes that are entirely altered and softened, creamy and yellowish in color, with spots and seams of limonite and cuprite, well fractured and possibly faulted, and with bodies of copper carbonate nearby.

For convenience the separate group of claims comprising the property will be taken up in turn, begining with those on the east covering the Elephant Head ridge. These are the Polar Star, Dippers, and Bob Cats. By far the greater part of this area is covered by the flow of rhyolite and the underlying limestones appear only along the northern third of the Polar Star and the Dippers together with the southern end of the Polar Star and a small area in the southwest corner of the Bob Cat. As a result the value of the claims is largely conjectural in the absence of development below the rhyolite. There is a vein of tough brittle, milky quartz containing silver bearing lead carbonate with stains of copper and manganese which appears near the east side line of the Dipper No. 2 about three hundred feet westerly from the north east corner of the claim. This vein strikes north 10 degrees west and dips 22 degrees to the east. It has been opened to some extent in the location hole of an old claim known as the Bullet Hawk, which runs across the northern edge of the company claims. A couple of open cuts towards the northern end of the Dipper No.1 shows another very flat lying vein of small extent. The yellow shaley limestone which comprises the only sedimentary rock exposed will probably be more apt to contain bunches of silver lead ore than dopper. Such development as should be done on these claims will probably be best located on the Polar Star under the Elephant Head proper, where several small dikes striking northerly are known to pass. There is a good runnel site on either end of the Polar Star, or the work could be from the adjourning Trund and Uncle Tom Extention

claims.

Copper Prize Group. The Copper Prize group consisting of four claims lying to the south of the Elephant Head ridge, have considerable development work already done. There are three dikes which have a general east and west strike which cross the side lines of the claims. The largest and most continous of these begins in the adjourning Back Bay claims and passes east near the northern end linesof Copper Prize No. 2 and 3 and continues across the Strong No 2, disappearing under the rhyolite cap just to the east side line of the later claim. A fifty foot shaft has been sunk on this dike just west of the gulcj on No 2 claim. At this point the porphyry is well oxidized andtoffers considerable promise of a body of desseminated sulphides below.The rocks on eitherside are heavily stained with limonite carrying occasional bits of copper carbonate and this particular ore seems to be the most promising for future development work. There is a long tunnel further up the gulch on the No. 1 claim which has been driven west to the intersection of a small dike crossing the west side line from the Hecla claim. This tunnel is about two hundred feet long and has been driven thro hard silicified limestone. At about 150 feet in the limestone is bleached and soft, and contains considerable desseminated pyrite. The contact of the dike strikes north 20 degrees east, dips thirty degrees to the east and is along a slip. At the 150 foot mark there is about 6 feet ofchalcocitized pyrite and a sixty foot winze was sunk at this point. The ore dips to the east and a fifty foot cross cut run at the bottom of the winze in this direction picks up this vein again at the face. It is a rather though somewhat altered limestone containing an abundance of chlorite and epidote with seams of massive pyrite; a few bunches of which has been chalcocitite, the soluble copper sulphate. While this particular locality contains a large amount ofdesseminated pyrite, yet it does not appear to be as favorable one as the area first mentined. Another dike crosses the number four claim a little south but little development has been done along this dike.

Strong Group.

The Strong Group of claims covers the area south and east of the Copper

Prize and Bobcat claims. Only one dike appears in this area striking east of north through the northern end line of the Strong number eleven. At the base of the ridge at the intersection of the dike and the west side line of this claim a rifty foottunnel has been run through the contact of the dike and the limestone. A few feet east of the tunnela forty foor shaft has been sunk. There are some copper carbonates in the first few feet of both shaft and tunnel, and the porphyry and surrounding rocks have been heavily oxidized. They have the appearance of a typical gossan, with spots and streaks of light yellow limonite. This area seems to be the most favorable locality for the future development of this group of claims.

Several of the old location holes have been located in the bright red streak at the base of the rhyolite, caused by the baking of the underlying rocks at the time the hot lava flowed over the surface. This is not a gossan and is without any economic significance. The ridge covered by the Strong numbers thirteen and fourteen has a cap of silicified limestone. This seems to be connected with several fissures striking northeast, one of which has a rather heavy gossan in the northwest corner of the number fourteen. The significance of this is at present problematical.

Ajax, Sinn Fein, and King Group.

The Ajax, Sinn Fein and King claims are located largelyon the alluvial fills of the valleys. The Sinn Feins, however, are on the ridge of limestone dividing the two gulches. There are two small dikes at the northern end of the Sinn Fein number one, and a long tunnel, located in the gulch just beyond the western side line, has been driven about three hundred feet towards the dikes. About half way in there is a narrow bed of chalcocitized desseminated sulphides which give promise of there being further ore in the vicinity of the dikes. The tunnel should be turned to the east and driven through thedikes. At the head of the gulch is another dike on the adjoining Empire claim which heads towards the main openings of the Northern Light number two just beyond the end line dividing the two claims. A tunnel about fifty feet long has been driven in the gulch just below the saddle and appoaches the dike at an angle. The last few feet of this is in a heavily impregnated bed striking

parallel with the dike. Although there is but little evidence of copper in the tunnel considerable information can be secured by turning the tunnel to the north west and driving directly to the dike.

Linda Vista, Bluebird Group.

The adjoining Linda Vista, Overaight, Basin Fraction, and Bluebird claims are located along the zone of partial contact metamorphism which extends to the southwest from the Henrietta and Uncle Tom claims. The chief work on the Bluebird occurs at the southern end of this zone. While the oxidized copper minerals are fairly abundant here, yet in view of the dissappointing results of the work done in other areas of this type of mineralization on the property further development can be best postponed for the time being.

Henrietta and Uncle Tom Claims.

There is well defined dike running along the southern boundary of the Henrietta and Uncle Tom claims, and the tunnel at the south end line of the Henrietta at the base of the hill enters the dike at the surface. The dike dips about 34 degrees to the east and at a distance of 130 feet in the tunnel, A winze has been sunk 25 feet. If this winze were continued 35 feetfurther it would intersect the hanging wall of thedike. Both the dike and the calcareous shals are highly oxidized and musty expecially along the water courses.At the face of the tunnel there is considerable pyrite bothas veins and desominated grains, with a little copper carbonate in it. Gypsum is abundant and it is evident that a considerable body of sulphides was formerly at this level. Whether the pyrite contains sufficient copper to form a considerable body of ore below cannot only be told by further development. One of the most productive leases on the property is located on the top of the hill near the center of the Henrietta claim. It will be well to continue the winze thro the porphyry and in the light of the information gained the best method of prospecting the hill can then be determined. At the northern end of the Uncle Tom claim the massive limestone was cut and a small shoot of oxidized lead silver ore was found, in the lease located at this point. The only significance of this is th a

it indicates the type of ore to be expected towards the edge of the zone of influence of the dikes. The several bodies of carbonate ore found along the ridge running through the Northern Light claim are probably related to the dike on the Henriotta and Uncle Tom claims.

Surprize Group.

The two tiers of claims east of and including the Elvira and Surprize are located in the limestone belt. The only dike observed on the surface is the on the follows ac cross the high hill on which the Elvira claim is located, and is responsible for the zone of intense contact metamorphism on the Elvira, Copper Queen, and Copper King claims. While some chalcopyrtie and pyrite was deposited at the time of the change of the limestone to garnet and epidote rock, and considerable copper carbonates and silicate have resulted from thier oxidation, yet the deeper development of the Elvira and Surprize tunnels has not disclosed any considerable amount of ore. Apparently the rocks were too tight and impervious to permit the secondary enrichment of the underlying sulphides. In the remaining claims of this group the limestone is fresh and unaltered and the only possibility of ore of commercial value are the bunches of silver-lead ore that may exist.

Bray-Boyd Group.

The Bray-Boyd group is located on the northern extension of the Elvira dike and zone of contact metamorphism. There is a small tunnel with a winze at the end at the bend of thegulch coming from the Verdi claim. As nearly as could be judged from the muck from the winze it had entered a zone of desseminated pyrite carrying a little copper. The main shaft of this group is located about fourteen hundred feet of the tunnel and follows a fissure striking northwest and dipping towards the north. A large open cut and tunnel has been driven along a parallel fissure about three hundred feet south of the shaft. Such pre as was produced seems to have been entirely oxidized, and nothing conclusive could be observed on the surface that would indicate they had struck a zone of desseminated sulphides on the lower level of the shaft. As these workings are located along a zone of contact metamophism our present knowledge of the possibilities of this type is not sufficient to warrent expectations

of any large bodies of ore.

Carrissa claims.

A branch from the zone of contact metamorphism extends south from the Elvira claim through the Carissa claims fraying out at the northern end of the Pedro and Daley. Much of the oxidized copper ores found on the Carissa claims is associated with this zone.

Copperopolis Group.

The Copperopolis and Crown Point claims have a thirty foot dike which has been traced for six hundred feet along the eastern side line of the Copperopolis claim. The dike is rather fresh but has been altered considerably on its southern half. The Copperopolis tunnel has been driven nearly parallel to the dike until it has intersected a fault the out-crops at the summit of the hill. The face of the tunnel it at present directly under the point of intersection of the fault and dike. The quartzite through which the tunnel has been driven carries a large amount of dessominated pyrite which has been somewhat chalcocitized at the winze, one hundred and fifty feet in. The face of the tunnel is in softened and altered quartzite carrying pyrite coated with films of chalcocite, and it seems likely that the next few feet of the tunnel will be in ore. It will be well to drive a drift along the fault to the west until the dike has been intersected. For some unknown reason the dike has not yet been intersected by the tunnel and it is probable that its dips to the west rather than to the east as is indicated by its outcrop. The work at this point is at the most favorable spot to prove the value of this group of claims.

Widow.

There has been no further work done since the last report in the Widow shaft. The vertical shaft just west of the incline evidently encountered a dike which did not appear on the surface and it will be well to start the cross cuts previously recommended at the bottom of the incline to find the extent of the ore appearing there and determine the position and relation of the dike to the west.

Sweet Maria Shaft.

The dike cut at the north end of the 120 foot level of the Glory Hole has

been traced across the claim past the Chase Shaft and beyond. The 120 foot level is the most significant development work on the property that has been done to the present. The dike cut in the north drift, N 4 X cut, and the N 5 W has been intersected again in the main cross cut. Only the eastern wall of the dike in the main cross cut shows a typical igneous contact. The remaining walls be- ing along the faults. On both sides of the dike is a zone of metamorphism in which the sedimentary rocks have been changed to chlorite rock containing deseminated grains and bunches of cuperferous pyrite, together with quartz-pyrite veins and str stringers. This zone is 100 to 200 feet wide gradually fadeing as it recedes in the dike. Where the rodk has been fractured or open grained it has permitted the enrichment of the pyrite thro the replacement of iron by the copper carried in solution by the surface water.

The close relationship of the sulphide ores to the dikes is here apparent. There is small dike running along the south wall of the S 2 W X cut, thro the bottom of the raise and across the station. A third dike occurs in the south drift near the south 4 east and each instance the ore has been of decidedly higher grade along the dike. The mere presence of a dike, however, does not necessarily mean ore of commercial grade as has been shown in the main W X cut, and it is evident that the ore bodies are to be found in shoots along the dike rather than as con- tinous masses. The main north drift beyond the dike contains spurs and stringers of porphyry for a distance of 60 feet. As the drift was continued, areas of gossan and sulphide ore succeeded each other in rather rapid succession. As the gossan is associated with minmor slips that have conducted the zone of oxidation down in fingers, it is evident that the drift is about the level of the upper boundry of the sulphides and gives promise of the zone of secondary enrichment extending to greater depths in this portion of the mine. The face of the drift at present appears to be entering a fault recognized on the surface as displacing the dike, near the north west corner of the Widow claim. As soon as the new shaft is completed, the No. 5 W X cut should be run, the No. 6 E X cut continued to the main fault zone, ~~and the No.7 and the main drift continued~~ and the No. 7

X cut driven west and the main drift continued until the limits of the ore bodies are known. The main W X cut seems to be driven largely in gossan, and it the last 75 feet has entirely a similer appearance to the new shaft about 65 feet above the 120 foot level. It will be well to drive a drift at the 250 foot mark to the south in order to properly understand the course the dike has taken. This should hit the dike within 80 feet, and will serve to locate any bodies of ore existing near the dike at this level. The shaft sholud be sunk at 100 foot below the present level. The main fault will be cut at the depth of 40 feet and it will be necessary to cross cut on the fifty and hundred foot levels thro to the west in order to get under the ore bodies. From the information gained it can be decided at which level the major development will be best accomplished.

Chase Shaft.

The ore in the Chase Shaft is very closely related to a dike striking a few degrees west of north and dipping at an angle of 20 degrees to the east. It has been offset by a fault passing down the shaft which stands nearly vertical, dipping steeply to the south above the 130 foot level, and to the north below that level. The dike has been cut on both sides on the fault on the 130 level, the northern block being offset to the west about 30 feet. On the 185 level only the south block of porphyry has been cut at the shaft. The W No. 2 N X cut was driven to cut the fault and intersect the foot wall of the dike. It cut the fault at the distance of 30 feet and is now under the porphyry. By cross cutting to the east the dike will be intersected, and the ore lies between this cross cut and the main north crosscut of the shaft. There is another dike, the one responsible for the ore in the Glory Hole, which passes about 100 feet south of the shaft on the surface. This should have been cut by the south cross cut on the 185 foot level, but a careful search failed to disclose its presence. The silicified "pseudo-porphyry" found in the last 80 feet of the cross cut is a contact metamorphic phase of the sedimentary rock. This cross cut should be continued for 40 to 50 feet and if the east and west dike is not intersected in that distance, the main east drift should be

driven under the saddle of the ridge where the dike crosses to the Glory Hole. The main west drift on this level should be continued to prospect the country across the gulch and at present appears to be in gossan. The dike encountered in this mine is probably a spur from the east and west dike and a cross cut from the main west dike on the 185 foot levelshould be driven south about 50 feet from the shaft station. This will follow the dike and give an opportunity to determine the failure of the east and west dike to appear in its proper position.

Contention Shaft.

The Contention Shaft has been sunk in sedimentaries containing a large amount of desseminated pyrite, and occasional streaks, where this seems to be softened and altered, have been chalcocitized until they form very high grade ore. The cross-cuts at the bottom are in similer rock and the face of the north cross cut is showing a decided improvement as it approaches the area of high grade carbonate ores located above. The west drift will intersect a fissured zone about thirty feet wide in the next 200feet. This zone is marked on the surface by a very heavy gossan which carries considerable copper carbonate in the open cut near the saddle of the ridge west. This work is very important as it will give us information both as to the meaning of the gossan and the testing of the hypothesis that the larger bodies of desseminated sulphide ores exist under the larger bodies of carbonates. Owing to the float from the triangular mass of phrphyry on top of the high hill north of the shaft it is impossible to determine the presence of a dike in the vicinity of the shaft. There is a dike which appears in the saddle west and heads in the general direction of the shaft which could not be traced beyonf a few feet from the saddle.

The group of claims lying imediately north of the campsite including the Dove, Raven, Sparrow, Happy, Mal, and Badgers, have a dike passing thro from the Dove to the Mal, and which has been cut at the face of the Raven tunnel. This entire tunnel from the mouth to 675 feet is in a contact metamorphic phase of the sediments and is in the dike for the last 65 feet. The rocks are all highly oxidized and evidently contain stringers of quartz and pyrite, together with some

deseminated pyrite grains. There are occasional copper stained and it has the appearance of a gossan. South of the tunnel at the foot of the hill both the porphyry and the sediments contain considerable carbonate ore. Several drill holes have been sunk in this area and if the records are available they should be obtained. On the surface this seems to be avery favorable spot to sink a shaft in the expectation of developing a considerable body of sulphides.

Vail Group.

The claims comprising the Vail group depend for their value upon the results of the development of the Vail shaft. Here a drift has been driven at 60 feet depth along a fault contact between a dike and the sedimentaries and the porphyry containing numerous grains of chalcocitized pyrite sufficiently abundant to bring it into the class of ore. The drift should be continued cross cutting the dike and a drift run along the dike itself. The dike to the east is copper stained in an open cut near the head of the ditch and about 600 feet further north in the gulch. If the dike in the Vail shaft proves up, the dike to the east will be equally agood prospecting ground.

Copper Queen Group.

In the Copper Queen group a similer test of the balues of the dike is being conducted in the Copper Queen shaft. In the work previously done by the leasers they followed a fault striking parallel to the dike and dipping at a steeper angle which carried them away from the contact. The cross cut nor being run should strike the dike within thirty feet, and its vaule ascertained. Several dikes cross the eastern half of this group and whereever the sedimentaries have been opened up they have been largely impregnated with deseminated pyrite. From the copper stains on the sludge from the drill holes put in this hill it is infered that a considerable body of sulphide ore is present. The Hammond shaft should be cleared out and opened to inspection.

Edison Group.

The Edison claims lie to the west. Two small dikes cut thro the extreme east and west borders, but the greater part of the area is in the fresh quartzite. A little

copper stain was found on the Edison claim near the south eastern corner and there is a possibility that some ore will be found at a greater depth, but at the present stage no extensive development is advisable.

Dean Lang Group.

On the Dean Lang group there are several dikes with copper stained local areas in their civinity. Of these the small dikes running north west toward the Dean Lang No.1 seems to show the more promise. Probably the best area to do any work on this group will be the short incline sunk on the fault near the center of the north side line of the No.1 claim.

Conclusions.

In conclusion it may be said that the first stage in the development of the property is now closed. It has been shown that large bodies of easily mined and milled sulphide ores exist closely related to the dikes. These bodies exist as more or less isolated lenses or shoots and two at the Sweet Marie and Chase Shafts have been developed to a sufficient extent to prophesy a successful future for the property.

The next stage in development is to discover further similar bodies of ore which but few if of like extent and value will be required to assure the mill and profitable operation. The geological conditions under which these ore bodies exist have been largely worked out and the future work will serve to test and add to the criteria necessary for the full interpretation of the various features of the surface. The property is now in a very enccuraging condition and the future development can be conducted on an enlarged scale with confidence.

Respectfully submitted.