Map same as Plates I + II in NBMG Bulletin 48

(91)

Item 19

See map files - 1 map

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CONTRIBUTION TO THE PUBLISHED INFORMATION ON THE GEOLOGY AND ORE DEPOSITS OF GOLDFIELD, NEVADA

In Professional Paper 66, U.S.G.S., on the above subject, Mr. F. L. Ransome recorded in 1909 the field work accomplished by himself, Mr. W. H. Emmons, and Mr. G. H. Garrey chiefly in 1905, and in a six weeks supplementary investigation by the senior author in the summer of 1908. This paper, ably written, has served as a text book on the District for the mine superintendents and engineers, who mined the ore bodies described therein, and as the basic reference for subsequent educational and scientific articles of a more general nature. 1/

Production of the Goldfield Consolidated Mines Company from 1908 to 1917, inclusive, (but including certain known production from some of the same mines prior to the consolidation*) was 3,094,253 tons of gold ore, averaging $23.40 per ton, or a total of $72,393,065. If the production of the Florence, Jumbo Extension, and miscellaneous early leasing operations is added, the camp's total somewhat exceeds $100,000,000 or, if sold

1/ The Mining Districts of Nevada, H. G. Ferguson, ECONOMIC GEOLOGY 24 (2) 1929; also reprinted Univ. of Nevada Bulletin No. 4, July, 1944 (repeats Ransome's erroneous conclusion that the Goldfield deposits are of post-Esmeralda age).

* This production by leasers or constituent companies prior to the consolidation was approximately $13,900,000.

at present prices, about $175,000,000. Subsequent to 1917, production was largely limited to that from tailings recovery and leasing operations. The Eastern Exploration Company, a subsidiary of Calumet and Hecla, while leasing discovered a shallow erratic pipe of high-grade ore in a complex vein structure near the Clermont shaft. Recovery from this pipe was about $622,000 (at the new price of gold), permitting the lessee, after payment of royalties, to recoup its expenditure for about 37,000 ft. of development, previously and subsequently performed.

Mr. Ransome published in 1910 a summary of Professional Paper 66 2/ but this article appears to have been based on the same field work, although there is a reference to disclosures at added depth in the Clermont Mine. The further discussion in the latter paper of the puzzling southerly termination of the Columbia Mountain fault and its possible relationship to the commercial mineralization of the camp, is quoted below:

> "Faulting has played some part in producing the present structure of the Goldfield district, the principal dislocation recognized being the nearly north-south Columbia Mountain fault. This has been traced from a point

2/ ECONOMIC GEOLOGY, Vol. 5 (1910)

nearly east of Kendall Mountain to the eastern end of the town of Columbia, a distance of two miles. It dips to the east at angles ranging from 20° to 55° and has a normal throw. The amount of this is not measurable but may be 400 or 500 feet. The fault appears to end about 600 feet northwest of the Red Top mine, the dacite at this place passing westward across the line of dislocation. South of the end of the fault the dacite is much fissured and the great ore bodies of the Red Top, Mohawk, Combination, Jumbo and Florence mines occupy a zone of great disturbance which lies in the general path of the Columbia Mountain fault. Throughout this entire zone the dacite is traversed by an extraordinary number of fissures which carry soft gouge and which in the aggregate undoubtedly record much movement. There is at present, however, no evidence that the dacite sheet as a whole has been displaced to anything like the extent it would have been had it been affected by the total movement represented by the Columbia Mountain fault. The hypotheses suggested as best accounting for the facts at present known are: (1) That the dacite was intruded after the main movement along the Columbia Mountain fault had taken place; (2) that the intruded magma to some extent followed the fault, possibly in some places coming up along it, and spread out where opportunity offered into sheet-like or laccolithic form; (3) that the Columbia Mountain fault continued, after the intrusion, to be a line of structural weakness and movement; and (4) that such renewed movements along the fault produced in the dacite, lying athwart the path of the dislocation, stresses which were relieved by complex fissuring of the brittle mass. Other stresses probably also contributed to this result, but it is believed that this revival of movement along the Columbia Mountain fault had a very important part in the fissuring and mineralization of the remarkable little area which has produced nearly all the gold thus far mined in the district."

The purpose of this present contribution is not to criticize Mr. Ransome's views, but rather to bring them up to date and to correct certain errors in the published record referable to the fact that his observations antedated much of the important development of the camp. If the article should seem critical, it is because brevity requires that it be devoted to discussion of the few errors in Mr. Ransome's structural opinions, whereas much is omitted that would confirm his usually sound and well-reasoned conclusions. Mr. Ransome made a one or two day inspection of a part of the Goldfield developments in 1915, but, as far as the writer knows, published no account of his then observations.

Familiarity with, or access to, Professional Paper 66 is assumed in the following discussion, which treats chiefly of those portions of it believed to be in error:

1. Relationship of the dacite to the other Miocene lavas.

The dacite in Goldfield is by far the most important rock. At least 70% of the ore has been produced from veins in dacite or on the contact of dacite with the latite. Ransome believes it to have been intrusive into the Milltown andesite and earlier rocks,

and this conclusion colors many other opinions throughout his publications. The writer believes the dacite in the principal area of the camp (that shown in Fig. 2, page 80) to be a flow that may be grouped generally with the Milltown andesite series of flows. It grades into the andesite in places by change of texture and gradual loss of quartz phenocrysts. There are variations within this area of the dacite, and in the andesites, as great as the difference between some of the rock mapped as dacite and that mapped as andesite. As stated by Ransome, the name Milltown andesite really covers several rocks, one of which is a tuff.

The dacite in the area of Ransome's Fig. 2 bears the same relationship to the underlying latite and other rocks and to the regional domical structure, as would be the case if it were a phase of the Milltown andesite series. This was pointed out by Locke in an early paper 3/ and Ransome's statement 4/ that the dacite does not accord with the general concentric plan that has resulted from doming and erosion is only true if the dacite is, a priori, differentiated from the Milltown andesite. It maps in this area as if it were a member of the Milltown andesites.

3/ Locke, A. The Ore Deposits of Goldfield, Nev., E. & M. J. 94 (1912).

4/ Opus cited, page 64.

Recent developments bear out the latter conception. The writer had the pleasure in 1913 at the International Geological Congress in Montreal of discussing this subject with Mr. Ransome; and pointed out that hypothesis number 2 in the paragraphs quoted above was no longer tenable, because subsequent development of the main Goldfield Consolidated vein had shown that, while this vein followed the dacite-latite contact through many irregularities, it did not fault that contact and no evidence had been found of dacite dykes or intrusions along it or along the Columbia Mountain fault, with which the main vein is in rough alignment. At that time, Mr. Ransome thought it likely that the principal transgressing intrusive source or connection of the dacite with depth lay westerly of the mine developments, as is also suggested on page 59 of Professional Paper 66, and illustrated in its section C-C, Plate VIII.

Plate II, published with this present paper, and the recent development, on which it is based, shows that the dacite is continuously underlain by latite for more than 2,000 ft. west of these Mohawk workings and, although upthrown to the west by the recently discovered continuation of the Columbia Mountain fault, extends far out to the west under the Siebert lake beds--behaving

everywhere like a flow. The writer has never seen in the hundred miles of the mine workings of this camp, any exposure that clearly indicated the dacite in the mineralized area to be in intrusive contact with any other rock.

2. The Siebert lake beds, also called Siebert tuff, are subsequent to the formation, mineralization, and some of the erosion of the Goldfield ore bodies.

It seems rather more remarkable that this conclusion was ever in doubt, for there are coarse gravel and boulder horizons intercalated in the lake beds that show waterborn fragments of vein material replacing the earlier Miocene lavas. Ransome admitted that such might be found 5/ and that they would be conclusive. But he stated his opinion that the Siebert formation antedated the commercial mineralization, and this published opinion of an authority undoubtedly had much to do with the remarkable fact that, while millions of dollars were being spent (and largely wasted) in seeking to the eastward continuation of the principal Consolidated vein in depth (or recurrence of similar mineralization in other veins), hardly a dollar was ventured subsequent to the publication

5/ Opus cited, page 175.

of Professional Paper 66, to discover what might underlie the lake beds to the west, in areas much closer to the known ore bodies, than many of the "wildcat" ventures to the east.

However, in 1919, Andy Berg found gold-bearing fragments in a boulder horizon within the lake beds approximately one mile south of Goldfield; and, in 1934, found a boulder of silicified rhyolite weighing 33 tons, which assayed from $10 to $100 per ton. A shipment of 32.2 tons from this boulder to the International Smelter in Salt Lake returned a gross value of 0.40 oz. Au. per ton. Subsequently, several smaller boulders of commercial grade were found in the same vicinity. This boulder with thousands of others of equal or slightly smaller size, mixed with coarse gravel, constitute one or more definite horizons in the lake beds, which are at least 500 ft. thick beneath the Berg boulder horizon and at least 300 ft. thick above it.

To the writer, this discovery was not surprising for on the "New level" of the Mohawk Mine an open stope once displayed a portion of the sub-outcrop of the Mohawk vein, unconformably overlain by the lake beds in one section of the stope, with the lake beds faulted against the ore by the post-mineral Mohawk fault in another section.

There can, now, I think, be no question about the fact that the Goldfield veins were formed, partially oxidized, and attacked by erosion, before there was substantial accumulation of sediments or tuffs in the upper Miocene lake. 6/

It follows that the eastern border of these sediments shown on Plate I of this paper, as in Professional Paper 66, is not necessarily the western border of the area that may contain commercial ore merely because there are no vein outcrops west of it, although until recently this seems to have been the conclusion since 1906 of all geologists and prospectors who have worked in the District. In the writer's opinion, there may well be ore under the Siebert tuff and Malpais basalt; and it seems odd, in view of the profits won from the camp, that more effort has not been spent in that direction.

The eastern border of the lacustrine formation is shown on Plate I of this paper as on Plate II of Professional Paper 66, as a somewhat arbitrary line. 7/ Small areas of both Siebert tuff and later gravels occur east of this line covering the earlier rocks and portions of the vein outcrops as shown on the section Plate II.

3. The Columbia Mountain fault does not terminate against the dacite north of the main productive area of the camp.

6/ University of California Bulletin Department of Geology. Volume 9 (1916) J. C. Merriam

7/ Opus cited Page 75.

After displacement by a combination of a sharp bend to the west and westerly displacement by subsequent east-west faults, this major structural feature continues with the same nearly north-south strike and easterly dip to and beyond the southernmost limits of development and known ore bodies. The outcrop of this southerly extension of the fault is some 800 or 900 ft. westerly of alignment with the exposed trace on Columbia Mountain, and at no point does it reach the surface, being covered throughout by from 50 to 200 ft. of alluvium and lake beds.

It seems remarkable, however, that this fault, marked by extremely heavy gouges and in many sections accompanied by low-grade ore or vein matter, has remained so long unrecognized, for it is disclosed in numerous mine workings and even developed as a vein by the Silver Pick Mining Company, on whose 500-ft. level it contained a small amount of low-grade ore and one typical spot of high-grade.

The sub-outcrop of this continuation of the fault, as now definitely established--first, by geophysical means, and confirmed by development--is shown on the geological map, Plate I, which accompanies this paper. Also shown on the section, Plate II, is the relationship in section of this fault to the principal veins in the northerly end of the camp, and the considerable dip-shift

(about 700 ft. in this section) of the flat westerly-sloping contact of the dacite and underlying latite, and of the deeper latite-shale surface.

It should be here noted that the exposed and previously known northerly segment of the Columbia Mountain fault is also attended with abundant low-grade mineralization and a few spots of commercial ore. This is mentioned 8/ but not emphasized in Professional Paper 66. Much of the earliest prospecting of the camp was centered on this structure; and although recent development of its southerly continuation has shown that the several million tons of mineralized and silicified rock that follow it are too low in gold content to be mined, it still seems possible that ore may be found near it to the south-west or in the section west of the Laguna Mine, where the fault will be found to have shale footwall and latite hanging wall.

The relationship of this fault to the series of gold-bearing veins on McMahon Ridge, which comprised the "ghost camp" of Diamondfield, is also of interest. On Mr. Ransome's map, the Columbia Mountain fault is shown as terminating where these veins begin; and in default of development, such termination is reasonable for exposures of andesite are unbroken in the further prolongation

8/ Opus cited, page 82.

of the northerly strike of the fault. However, the rhyolite-andesite contacts and alteration, by which the position of the fault is determinable north of the Adams development, turn still more to the north-east and fall into alignment with the Diamondfield fissures and silicified outcrops. The fault does not end suddenly; it makes another of the remarkable sharp turns to the east, and becomes dissipated in the structure of McMahon Ridge. It is furthermore true that small prospecting operations since Mr. Ransome's examination have disclosed minor amounts of rich ore--specimens and the like--in the little developed section of the fault between Columbia Mountain and Diamondfield. On an empirical basis, there is almost no production from this district, except that of the Sandstorm Kendall, that could not have reached the place of its deposition through known channels connecting with the Columbia Mountain fault.

One possible exception perhaps deserves mention. No breccia or explosion pipes have been described or mentioned as occurring in Goldfield, and the writer knows certainly of none. But the lower developments of the Reilly ore body between the Florence and Combination Mines disclose a width and quantity of brecciated dacite and latite, that is somewhat difficult to explain as an autoclastic or fault breccia, such as that which constitutes the central "stope streak" or high-grade brecciated and mineralized shear found at the median plane or core of all of the really productive

veins. The bottom of the Reilly ore at 280 ft. from the surface contained abundant famatinite and some sphalerite, resembling the ore mined from the Consolidated vein below depths of 1,000 ft.

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A more detailed account of recent developments in Goldfield may lend support to the modified structural and geological concepts hereinabove briefly outlined, and thus contribute to estimation of the possibilities for additional commercial development.

The writer was geologist for the Goldfield Consolidated Mining Company in 1911-13, inclusive and kept in touch with developments by occasional visits until 1915. This period probably embraces the maximum expansion of accessible developments in the Goldfield Consolidated, Goldfield Merger, and Jumbo Extension Mines. There are certain developments in the latter two properties, and in the Atlanta and

Goldfield Deep Mines Company shafts, which he has never seen. But, as workings in this camp do not remain open long, it is believed that the following remarks may be based on maximum access to developments, particularly in the lower part of the mine.

To the writer, and it would appear also to the authors of Professional Paper 66, the source and origin of the Goldfield ores were very much of a puzzle. As indicated in the appended section, Plate II, there is little evidence, in the deepest development of the main Goldfield Consolidated vein, of any conduit or source of the ore in the plane or area of the downward extension of this main vein or its ore bodies. At the time Mr. Ransome wrote Professional Paper 66, it had already been established that the Combination, Jumbo, and Sheets-Ish veins very probably died out, in depth, along the dacite-latite contact, or were non-commercial in the latite. The senior author of the paper showed conservatism at that date in only hinting at the probability that the main Mohawk vein would bottom in the same way. 9/

9/ Professional Paper 66, pages 174-200.

In his later paper 10/ Ransome was apparently relieved to know that the main vein was continuing into the Clermont in the latite. From the 450 to the 650 levels, roughly, of the Mohawk-Clermont Mine, the vein occupied the contact between the latite and dacite, which in this section sloped easterly at about the dip of the vein, to the "keel" of a boat-shaped depression above the 750 Clermont level. From this level to an irregular line below the 1000-ft. level of the Clermont, the vein --narrowing and becoming more lode-like--was entirely in the latite. Where it followed the dacite-latite contact, there was nothing to suggest that the vein altered the pre-vein configuration of the irregular latite surface, although both rocks were silicified and highly mineralized. There was no general faulting of the contact by the vein and, except for the post-mineral Mohawk fault, there is, in fact, no displacement over 20 ft. or so of any of the flow contacts north of the Florence Mine.

When, on its downward course, the vein reached the pre-latite surface or unconformable contact with the Pre-Tertiary rocks, there was even less in the way of fissuring that extended down into the shale, upon which for the most part the latite, in the ore-bearing area,

10/ Economic Geology, Vol. 5, 1910.

rested. In the Jumbo Extension Mine, as contrasted with the Grizzly Bear shaft (both of which develop the main vein on this latite-shale contact), there were within the vein zone one or two weak flat fissures that penetrated the shale with trifling displacement and with little mineralization. The numerous small steep faults that served to increase the irregularity of the unconformity were unmineralized and, for the most part, older than the ore.

Wishful thinking, at the time, tended to overemphasize or even exaggerate the possibilities of this great vein extending down into the basement complex 11/, but the plain facts of the situation are that it came down upon the pre-latite surface and died out. The lower levels of the mine were essentially contours on the Tertiary surface. One ore body in the Jumbo Extension actually filled a small erosinal gully in the shale. The latite showed some alunitic alteration to the bottom; but there was less alunite, more kaolin, and more pyrite in the lower part of the latite, which also showed marked flow structure and many small inclusions of granite and shale.

11/ Mining and Scientific Press; June 26, 1914; Page 995

Persistence of a relatively high p H in the mineralizing solutions at this elevation was, however, attested in a striking and interesting way. The basement Cambrian shale, in the area opened by development particularly in the Grizzly Bear section, is calcareous and, in the shaft crosscuts, is traversed by a multitude of ramifying stringers of white calcite. Within 10 ft. to as much as 40 ft. under the mineralized latite contact, these calcite stringers were decomposed, leaving a greasy, white selvage of kaolin and extremely fine silica, which would not effervesce with hydrochloric acid.

The ore in these levels was extremely "base" and, for the most part, was not treated in the Consolidated mill, but was shipped to copper smelters in Nevada and Utah.

The production of such ore from the Grizzly Bear shaft in 1913-15, inclusive, was 22,408 short dry tons, assaying 1.07 oz. Au., 5.58 oz. Ag. and 4.21% Cu. Clean-up operations in 1917 and 1918 added 23,638 tons, averaging 0.31 oz. Au. and 1.13% Cu. so that the total output of this base ore lying on the shale in the Grizzly Bear area was 46,045 tons, averaging 0.68 oz. Au. and 2.63% Cu.

The Jumbo Extension during the year 1915 shipped 22,562 tons, averaging 1.35 oz. Au., 4.41 oz. Ag., and 2.79% Cu. Figures for 1914 and 1916 are not available, but the 1915 production was approximately half of the total mined.

The Atlanta property shipped a total of 1,832 tons of considerably lower value, from a small extension of the Grizzly Bear ore through the Merger Mine workings.

More than a decade after this ore had been mined and the levels abandoned, the Goldfield Deep Mines Company sank a deep shaft to the southeast of these developments (see Plate I for location) and, at a depth of 2,150 ft. (elevation 3986), drove more than 4,500 ft. of crosscuts and laterals in the area of the geometrical extension on dip of the main Consolidated vein system.

This shaft passed from latite into alaskite at about 1,450 ft. From 1,740 to about 1,800 ft., it passed through an inclusion or pendant of limestone. Except for the latter, the shaft and all development below 1,400 ft. were in alaskite, with no structural or mineralogical evidence, or trace of any kind of the Goldfield Consolidated vein or of a conduit to it. Except for a few short tight lenses of quartz and, in one instance, of pyrite, these developments were devoid of mineralization.

Unfortunately, the work did not extend far enough west to cut the downward projection of the Columbia Mountain fault.

With the recent initial applications of geophysical work to mine exploration, as distinguished from oil exploration, the writer, deliberating on the -- to him--unsolved problem of the source of the Goldfield ores, encouraged Newmont Mining Corporation to undertake geophysical surveys in the westerly part of the Goldfield District, to determine whether or not veins exist underneath the post-mineral Siebert lake beds. Magnetometer surveys in 1945 indicated the existence of such veins under the relatively shallow lake bed cover, west of Columbia Mountain. Subsequent diamond drilling corroborated the existence of one or more veins indicated by the magnetometer, but failed to encounter ore within them.

However, with this encouragement, the Silver Pick shaft, which was the most westerly accessible development in the northerly section of the camp, was reopened and examined, with the discovery of much of the information shown on section Plate II. It was immediately suspected that the vein, hitherto known as the Silver Pick vein, was in fact the Columbia Mountain

fault. Enough work was done to the north on the 500 ft. and 271 ft. levels to show that the fault turns northeasterly and then easterly, as is required to couple it with the exposed section of the same feature on Columbia Mountain.

The fault-vein was also developed south for several hundred feet, in the hope of finding ore bodies. But while the fault is continuously alunitized and carries several--to as much as 50--feet of silicified and pyritized dacite on its hanging wall side, commercial ore was not found in sufficient quantities to justify mining. This fault-vein differs from the normal Goldfield veins in that the silicified rock along it has, in the Silver Pick Mine, been reduced to a breccia by post-mineral movement along the thick gouges, which constitute the fault. This breccia carries from $1 to $5 gold per ton. In the development of this feature on the Silver Pick 500-level, to the south, it became apparent by projection, that it is the same fault structure, separating the dacite and latite, that passes through the bottom of the January shaft, as shown on Ransome's section of that shaft. 12/

The January vein thus physically connects the Columbia Mountain fault with the Combination and, through

12/ Professional Paper 66, Plate XVI.

the Reilly ~~Riley~~ workings, with the Florence vein. This connection is roughly at the elevation of the bottom of the dacite sheet.

There is some similarity between this structural departure of a series of linked veins, constituting a compound lode controlled by a shear zone or fissure system with very little displacement, branching off from the Columbia Mountain fault at an irregularity in the strike of the latter, with the more striking and evident formation of the main Goldfield Consolidated fissure zone, which, at the north end of the Red Top Mine, splits off of the hanging wall of the same fault, at the point where the latter makes the sharp westerly bend at the southerly toe of Columbia Mountain. In the latter case, the lode-like Goldfield Consolidated vein is almost exactly in the prolongation of the plane of the Columbia Mountain fault north of this turn. It evidently represents a shear zone or series of cracks, formed in extenso, as it were, of the northerly part of the great fault, without sharing appreciably in the movement that occurred on the fault itself.

The Mohawk fault, however, which is nearly parallel in strike but steeper than the Columbia Mountain fault and Consolidated main vein, doubtless was formed

by and represents some of the post-mineral movement that occurred on the Columbia Mountain fault. The Mohawk fault extends clear through the Goldfield Consolidated Mine and as far south as the Florence shaft. It has a post-mineral down-throw of approximately 90 ft. on its hanging wall or eastern side in the section of the Mohawk shaft, more to the north and less to the south.

The Sheets-Ish vein could easily have had direct connection by fissure with the Columbia Mountain fault; whereas the Clermont and Jumbo may well have been mineralized from their larger neighbors, the Goldfield Consolidated and Florence veins. The position of the Sheets-Ish and Hampton stope seem significantly related to the dome in the top of the latite between the Columbia Mountain fault and the east-dipping slope of this contact that is followed by the main vein.

The above discussion is not proof, but it justifies the hypothesis, enunciated on pages 9-13, that the Columbia Mountain fault is the chief source of the Goldfield mineralization. If such is the case, there is legitimate reason to believe that ore bodies may still exist in its vicinity in portions of the District that have not yet been explored.

About 1919, a company, operating certain leases on the Florence Mine, drove an exploratory crosscut a thousand feet due west from the Florence shaft at the 358-ft. level. In 1947, Newmont Mining Corporation rehabilitated and extended this crosscut about 1,000 ft. and intersected the Columbia Mountain fault on its projection (and where indicated by magnetometer surveys) 2,500 ft. south of the Silver Pick development. In this section, its sub-outcrop is covered by 110 ft. of lake beds. Two small nearly vertical veins in the andesite were encountered about 300 ft. east of the Columbia Mountain fault. These veins contained substantial values in gold, the more westerly carrying areas of high-grade ore. Some of the gold occurs with sphalerite in a manner similar to that described by Tolman and Ambrose 13/ in ore from the Mohawk Mine, but the greater part of it occurs as calaverite.

Four hundred feet further west, two larger veins occur close to the Columbia Mountain fault. In one of these, the gold values are erratic and probably not high enough to mine. The other contains bonanza ore, at least locally. Both occur at a pronounced westerly turn or swing in the main fault vein, which is at least partially referable to a crooked northerly-striking fault. All of these smaller ore-bearing veins

13/ The Rich Ores of Goldfield, Nevada. Economic Geology 29, 1934.

strike about N 20° W, but vary from a steep westerly to moderate easterly dips. It would appear, although this has not yet been fully demonstrated, that their thickness and gold content are functions, not constant however, of the distance of the development from the Columbia Mountain fault. The most important of these veins, as at present developed, may be actually seen departing from the low-grade pyritic mineralization of the Columbia Mountain fault, like a branch from a tree trunk; samples containing five ounces gold can be cut across the branch vein within six feet of the apparently earlier flat-dipping pyritic quartz which carries only five dollars per ton.

It is intended to further develop the structure above broadly outlined. So far, nothing of value and, with the single exception of the Sandstorm Kendall Mine, almost no ore has been found at any considerable distance to the west or in the foot wall of the Columbia Mountain fault.

While the hypothesis is at present largely conjectural, the writer considers that whatever the original source of the gold in this bonanza camp--perhaps a rhyolite vent or plug or breccia pipe--its distribution was accomplished by the Columbia Mountain fault. A proposal as to the details of such distribution involves

analysis and criticism of Chapter XVI of Professional Paper 66. Even if the writer were qualified to engage in such discussion, to attempt it here would unduly distend this present paper.

FRED SEARLS, JR.

December, 1947.