THE GEOLOGY OF POORMAN MINE AND ADJACENT AREA,
BOULDER COUNTY, COLORADO

By

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The Geology of Poorman Mine and Adjacent Area, Boulder County, Colorado

Thesis directed by Professor W. Warren Longley

A detailed investigation was made of the geology and petrology of Poorman Mine and adjacent area. The region is about five miles west of Boulder, Colorado, along the road to Gold Hill. It is underlain by Boulder Creek granite-gneiss cut by two well known 'dikes', named Poorman and Maxwell, which intersect at the south-east corner of Poorman Hill. A careful study of the rocks indicates that the pegmatitic and aplitic material of the 'dikes' is closely related to Boulder Creek granite-gneiss. The granite-gneiss intruded this area, the upper zone solidified and fractured, but differentiation of the lower portion continued to produce an acidic magma, which was injected into previous fractures to form the 'dikes'. These 'dikes' do not contain ore. They acted as impermeable barriers which controlled the trend and position of the channels penetrated by the ore solutions. The veins in this area are of fissure-filling type, consisting of gold tellurides, silver ore and some common sulphides, within a black dense quartz material. They are lenticular, localized, of a spotty nature. Since the top portion of two hundred feet depth on Poorman Hill has been mined out during last sixty years, it is suggested that for future exploration it would be advisable to follow the contact between the country

rock and the Poorman 'dike' below the 200-level within the Poorman Mine.

This abstract of about 227 words is approved as to form and content. I recommend its publication.

Signed W. Warren Longley
Instructor in charge of dissertation

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INTRODUCTION

Purpose

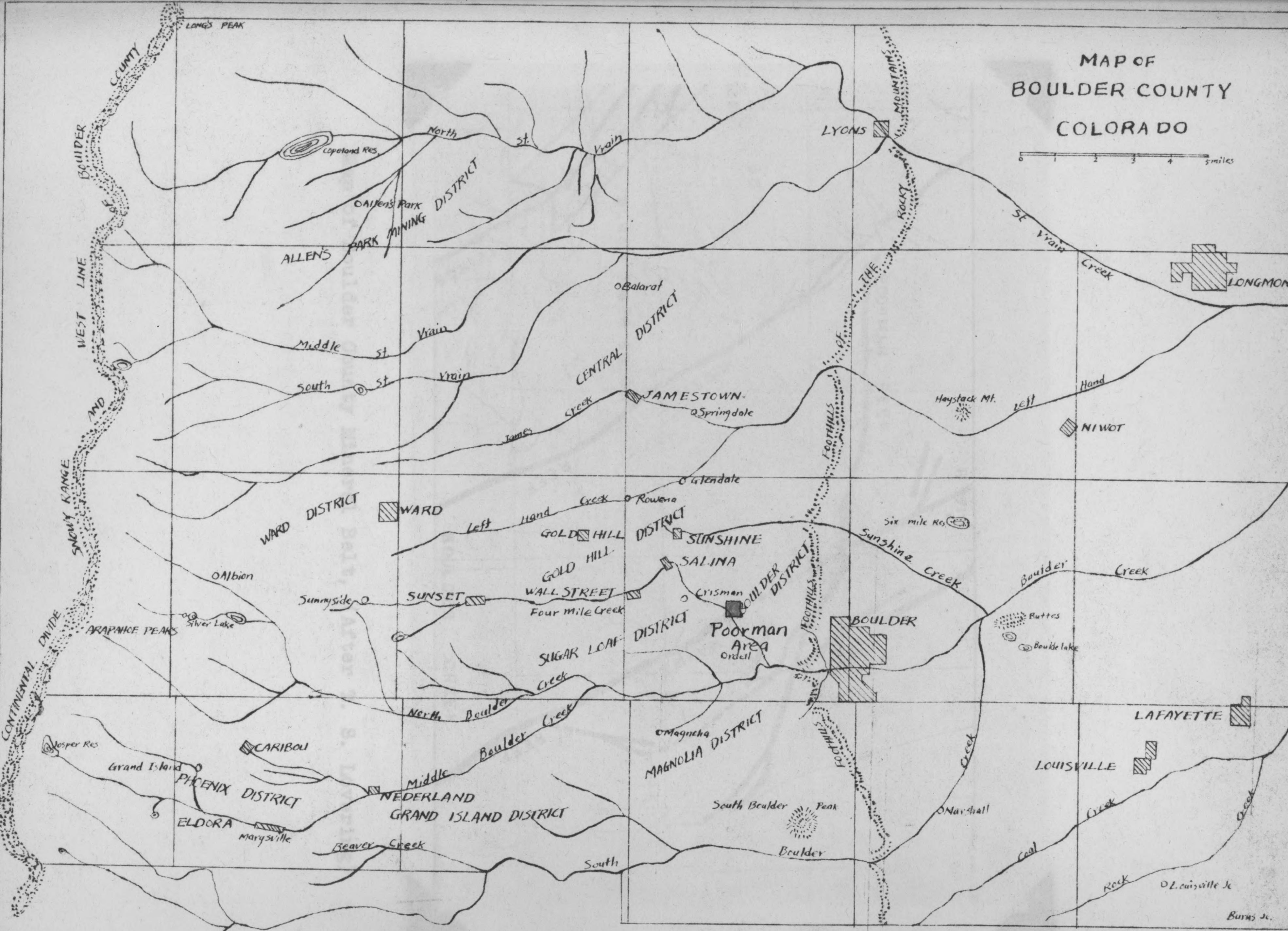
The purpose of surveying Poorman Mine and adjacent area was to make a detailed investigation of the geology and petrology. The Poorman Mine is one of the oldest gold producers in Boulder County, Colorado, and its full description with respect to geology was not available before this paper was written. The writer was assigned this work by Professor Ernest E. Wahlstrom as a Master's Thesis in the Department of Geology at the University of Colorado.

Location

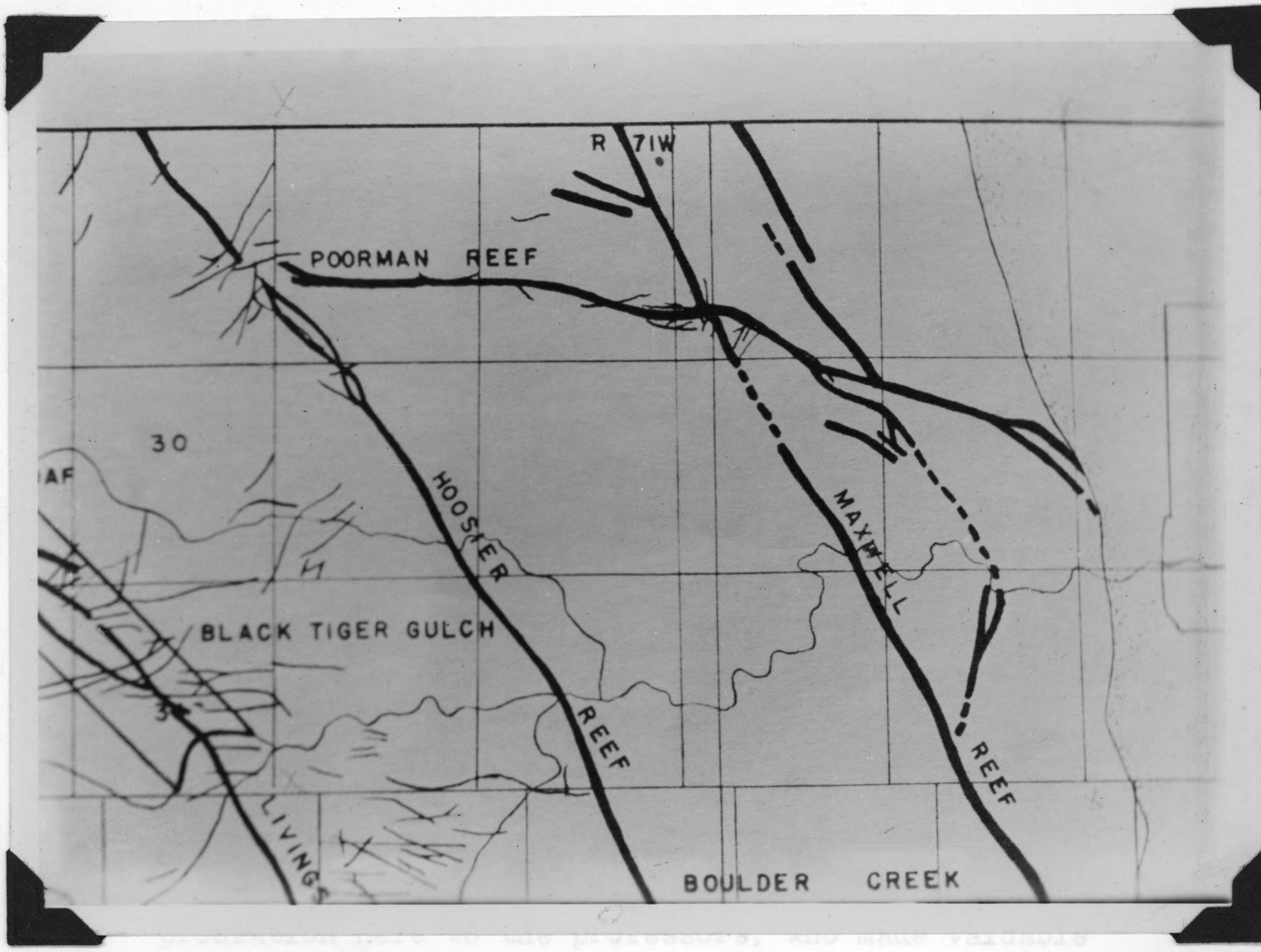
The area examined is about five miles west of Boulder along the road to Gold Hill. It is about one square mile in extent and is located about Poorman Hill. It is shown by a topographical map (Map 1) attached to this thesis. Index map on the following page gives the relative position of this area and the mining districts of Boulder County.

Climate

Nature provides a wonderful climate during the entire year in this area. The annual temperature is about 50 degrees with a mean summer temperature of 67 degrees. The annual precipitation is 18.11 inches. The relative humidity is, in general, very low with the result that the warmer days ordinarily are quite comfortable. The



From "Report of Mines and Mineral Resources of Boulder County, Colorado"



Map of Boulder County Mineral Belt, (After T. S. Lovering) altitude is about 6,300 feet above sea level.

Area Mapped

The topographical map was enlarged from a map of Boulder Quadrangle, Colorado, on a scale of one inch equal to one mile. Some modifications have been made to bring the map up to date. All geology, surface and underground mapping were done by the writer during the period of Spring and Summer Quarters, 1947.

Field Methods

Mapping of underground and surface geology was done by the writer by means of chain and compass surveys. The surface map was made with the aid of a plane table and telescopic alidade. All field work was carried out in the Spring and Summer Quarters of 1947.

Acknowledgements

The writer would like to express his sincere appreciation here to the professors, who made valuable suggestions about this thesis, and to the friends who actually helped in making the surface and underground maps of the assigned area.

HISTORY OF MINING IN POORMAN DISTRICT

The Poorman Mine is situated in the Boulder Mining District about two miles from the junction of Fourmile Creek and Boulder Creek along the road to Gold Hill. The heart of the district is Poorman Hill, which attracts one's attention when returning from Gold Hill via Salina and Crisman and just before reaching the mouth of the Fourmile Creek. There were twenty three patented claims recorded in this district; Poorman's Relief was one of them. It was discovered May 14, 1878, by John J. Ritchey and Dennis Quick.[1]

Mr. William Laffea, an experienced miner and at one time owner of Poorman's Relief, has explained the name of Poorman. It was named by the discoverer, Mr. John J. Ritchey, because his finding would be a relief to many poor men working there.[1]

The Boulder Mining District is one of the smallest and oldest in this county. It was used to define part of the boundary of Gold Hill District in July, 1859, and also marked the east boundary of Sugar Loaf District in November, 1860.[1]

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(1) Fritz, P. S., "The Mining Districts of Boulder County, Colorado", Unpublished Thesis in the Department of History, 1933, pp. 158-249.

According to Boulder Metal Mining Association's publication, "Mining in Boulder County", the Poorman Hill mines had produced $250,000 worth of gold up to 1915.[1] The figure is necessarily larger now with the addition of the production in the last twenty to thirty years. As elsewhere in this country, many ores running into hundreds of dollars per ton have been found on this hill, but in the early days the veins usually yielded $8 to $16 per ton.

During recent years, this mine has been operated by lessees with little ore being produced. Most of the work has been done by surface openings, the deepest shaft being not over 600 feet. Miss W. A. Clark, the present owner, is a resident of Boulder, Colorado.

When the writer mapped this area in the Spring of 1947, two men were engaged in working this mine. Most of the tunnels below the 200-level of the Poorman Shaft were caved in and in bad shape. The 575-level in particular was full of water which prevented further investigation. The entrances to other tunnels and shafts were also closed, except the Unknown Tunnel and Yates Tunnel.

Just before the writer finished his field work, a geologist from Denver tried to reopen the Poorman Mine and some repairing and investigating work was going on in the area.

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(1) Boulder County Metal Mining Association, "Mining in Boulder County", 1915, p. 39

GEOLOGY OF THE AREA

Physiography

The area lies west of the eastern flank of the Front Range of the Rocky Mountains. The mine is situated on Poorman Hill, which is 6,400 feet above sea level. The lowest elevation in the Poorman region is less than 5,700 feet, which gives a vertical range of about 700 feet. At the south-west side, the area is drained by Fourmile Creek (Figures 1 and 2) with a few intermittent streams which have produced a comparatively steep canyon. There are gentle slopes along Sunshine Canyon on the north-east side of Poorman Hill with a considerable amount of soil accumulated in the lower portions (Figure 3).

There are two well known "dikes" named Poorman and Maxwell, intersecting at the south-east side of Poorman Hill. Six branches from Poorman "dike" are formed near this intersection with four in a general south-west direction and two parallel to the main "dike". The trend of the Poorman "dike" is generally east-west and deflects south-eastward after crossing Fourmile Creek, but the Maxwell "dike" has a strike of N 30°E almost perpendicular to Poorman "dike" and branches out at a place about 2,500 feet northward from Poorman Hill running southeasterly to meet Poorman "dike" at the east boundary of the area mapped. The knife-shaped ridges of Poorman "dike" stand several feet above the

Figure 1. A view of Fourmile Canyon taken from the south-west side of Poorman Hill

Figure 2. Looking north-west toward Fourmile Canyon and the Boulder Gold Hill Highway.

Figure 3. Looking eastward toward Boulder City from Sunshine Canyon, showing the gentle slopes on both sides of Sunshine Canyon.

surface (Figure 4). The "dikes" are highly sheared and silicified in the area between Sunshine Canyon and Poorman Hill. The ridges are lacking in the Poorman and the rock is not so highly sheared and silicified at the west side of Poorman Hill. The Maxwell "dike" is generally not well shown in this area, except for a very few scattered low ridges (Figure 5)

By studying the present physiographical features, it is apparent that the distribution of different types of rocks did not influence topography. The valleys of streams are narrow, and the tributary streams form interlocking spurs at the junction with the main valley, showing that glaciation has not played any part in the geologic history of the area.

Geologic History

The granitic body was formed in pre-Cambrian time. Some of the intrusive rock has a gneissic structure. The granite has tabular feldspar and biotite crystals which indicate the direction of the magmatic movement just preceding consolidation. Because the compressive forces acted in a north-south direction, this action gave the granite an east-west structural trend.[1] Faulting then followed in the area, which gave generally two sets of fractures, one with a strike approximately north-south

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(1) Wilkerson, A. S., "Geology and Ore Deposits of the Magnolia Mining District and Adjacent Area, Boulder County, Colorado", Colo. Sci. Sec. Proc., vol. 14, No. 3, p. 83.

Figure 4 A view taken from the south-east side of Poorman Hill, showing the knife-shaped ridges of Poorman "dike".

Figure 5 An isolated ridge of the Maxwell "dike" on south-east corner of Poorman Hill.

and the other east-west. The pegmatitic and aplitic intrusions followed these zones of weakness to form the Poorman and Maxwell "dikes". There may have been movements during Paleozoic and early Mesozoic times, but evidence is lacking. The above-mentioned "dikes" were fractured and granulated at the end of the Cretaceous period due to mountain-building forces. Silicification came afterward and the secondary intrusions followed which are the present formations of rhyolite and dacite.

Structure

The area is located within the Boulder Creek granite-gneiss, which is the oldest rock with foliation striking east-west and dipping steeply to the north. Pegmatitic and aplitic "dikes" are abundant, and are generally divided into two groups; one running approximately east-west, and the other north-south. A glance at the surface as well as underground shows that these "dikes" were intruded along the fractures, which might be faults or some other types of openings. Full evidence proves they are younger than the granite because of absence of the traces of metamorphism. Dark lenticular masses of one foot or less in length have been found in great number included in the granite.

The Poorman "dike" strikes east-west from Logan Hill, running eastward into this area and bending slightly southward into Sunshine Canyon on the west side of Poorman

Hill, where it changes its bearing from N 71°E. to N 79° E. The "dike" intersects with Hoosier "dike" on Logan Hill and with Maxwell "dike" on the south-east side of Poorman Hill (Map 1). Near the latter it branches out into six small "dikes" with four of a general south-west direction and two parallel to the main "dike" itself. One of these makes a loop at the middle of its course. The main body of Poorman "dike" carries on to the east and meets a branch of Maxwell "dike" about one thousand feet away from the first intersection. This branch splits out from the main "dike" of Maxwell about 2,500 feet away to the north of Poorman Hill. This Poorman "dike" was formed by an intrusion of pegmatitic and aplitic material along the fault plane without any economic mineralization. The brecciation occurred at a later stage, which was then followed by the silicification. The width of this "dike" varies from place to place and in one part of the Poorman area it is about one hundred feet wide. The contact between the "dike" and the country rock is sharp in a few spots (Figure 6) and is gradational at other places. At Logan Hill, it is a highly silicified fault breccia and is reported to contain small quantities of gold. Near Poorman Mine, it is an iron-stained fault breccia, cemented by fine-grained quartz, but on the hill-side south of the road in Sunshine Canyon, it is a conspicuously coarse breccia. It is very hard to tell the age relation between Poorman and Maxwell "dikes" as they have a similar mineralogical composition. They might be genetically related. The evidence of displacement between them can not be found, which may give one an idea that these "dikes" might have intruded at the same time.

The Maxwell "dike" is an iron-stained silicified fault zone intruded by pegmatitic and aplitic material (Figure 7) and generally about ten to forty feet in width. It starts north of Allen's Park and goes south-east to Green Mountain, a distance of more than twenty miles with a general strike of N 30°W. The "dike" formation in Poorman Hill is shown on the surface with a few isolated portions standing up about ten to fifteen feet high. The Maxwell "dike" branches out about 2,500 feet away at the north side of Poorman Hill. The Main "dike" intersects the Poorman "dike" on the south-east side of Poorman Hill, but its branch meets Poorman "dike" about one thousand feet away to the east. As described by A. S. Wilkerson,[1] an exposure of this fault zone has been located in Boulder Canyon. In some places it is about ninety feet wide and shows evidence of shearing, but the more highly silicified portion is not more than twenty five feet wide with a dip of 80 degrees southward. The movement of the hanging wall with respect to the footwall is also well shown by a highly polished and locally grooved surface on the latter.

Two faults have been found on Poorman Hill, and the evidence is well shown underground (Maps 2 and 3). Both

(1) Wilkerson, A. S., "Geology and Ore Deposits of Magnolia Mining District and Adjacent Area, Boulder County, Colorado", Colo. Sci. Soc. Proc., vol. 14, No. 3, p.89.

Figure 6. A view of Poorman "dike" with sharp contact, exposed on Boulder Gold Hill Highway.

Figure 7. Maxwell "dike" exposed along the Sunshine Canyon Highway, showing the brecciated mass of the "dike".

of them have dislocated the Poorman and Maxwell "dikes" considerably. One fault has a strike of N 50°W, with a dip of 45 degrees to south-west and the other has a strike of N 70°E with a dip of 60 degrees to north-west. The mineralizing solutions have gone up along these openings and a small amount of valuable ore has been mined from them locally. The length of these faults is well exposed on the extremities of the drifts shown on the attached Map 3, but only a vague trace is found on the surface.

PETROLOGY OF THE AREA

The Poorman Hill area is underlain by Boulder Creek granite-gneiss and a large number of pegmatitic and aplitic "dikes". Although this granite-gneiss varies in texture from place to place, the entire outcrop has been mapped with no attempt to distinguish the various phases. Schist inclusions from the Idaho Springs formation can be seen within the granite-Gneiss. The large bands of the schists are well exposed along the highway excavation. Since they do not belong to Poorman area and are not common, the writer has spent no time on them

Boulder Creek Granite-Gneiss (Figure 8)

This is a gneissic biotite granite and ranges from coarse-grained to porphyritic in texture. According to previous reports,[1, 2, 3] it is a pre-Cambrian rock. The fresh surface of this rock ranges from a light gray to dark gray, depending entirely upon the proportions of mafic minerals present. Sometimes a pinkish color is also found, which is considered as a mixed product of biotite granite and aplite or pegmatite. The weathered surface has a brownish color due to the decomposition of the

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(1) Fenneman, N. M., "Geology of the Boulder District", U. S. Geol. Survey Bull. 265, p. 35.
(2) Lovering, T. S., "Geologic History of the Front Range, Colorado", Colo. Sci. Soc. Proc., vol. 12, No. 4, p.68.
(3) Wilkerson, A. S., "Geology and Ore Deposits of the Magnolia Mining District and Adjacent Area, Boulder County, Colorado", Colo. Sci. Soc., Proc., vol. 14 No. 3, p.84.

dark minerals. Flow structure is usually present. The lenticular inclusions within the biotite granite range from a few inches to one foot in length. By studying the relationship between them, the writer would say that these inclusions are the residual portion of the schists left by the process of assimilation.

A hand specimen of the biotite granite is coarse-grained with the feldspar phenocrysts conspicuous and uniform in size. The mineralogical constituents are quartz, feldspar and biotite, with some magnetite and hornblende. The striations on the white feldspar are due to albite twinning. The white grains of feldspar make up approximately 50 per cent of the rock, while quartz, of the colorless variety, and biotite form most of the remainder. The particles of magnetite and hornblende are small, and can be identified with the aid of a handlens.

Under the microscope, the rock assumes a comparatively different appearance with kaolin and sericite clouding the orthoclase (Figures 9 and 10). The rock is coarse-grained, with feldspars, hornblende and biotite phenocrysts set in a finer-grained groundmass of quartz, feldspars and other minerals. Orthoclase constitutes a large proportion of the rock. Carlsbad twinning is characteristic of the orthoclase phenocrysts, and the index of refraction is less than that of Canada balsam. Quartz composes about 25 per cent of the rock and shows undulatory extinction with some gaseous and liquid inclusions. Microcline has a cross-hatch twinning. Oligoclase has an average extinction angle of about 7 degrees with carlsbad twinning, and its index of refraction is 1.549. Biotite is of the brown variety showing strong pleochroism and a moderate relief, Hornblende appears greenish in color with cleavages in two directions at angles of about 55° and 125°. Its relief is rather high. Traces of apatite, titanite, epidote and magnetite are also found. The representative mineralogical composition determined by Rosiwal analysis is as follows:

	Percentage
Apatite	00.20
Biotite	15.00
Hornblende	7.00
Titanite	00.10
Magnetite	1.00
Epidote	00.70
Microcline	7.00
Orthoclase	28.00
Oligoclase	16.00
Quartz	25.00
Total	100.00

Aplite and Pegmatite

As the "dikes" on Poorman Hill have approximately the same mineralogical constituents, the writer is considering them as a whole.

The "dikes" of Poorman and Maxwell are highly brecciated, fractured, and silicified. From the north-east side of Poorman Hill to the hill-side south of Sunshine Canyon, the iron-stained color and a conspicuously coarse breccia is shown on both "dikes", but a fault breccia cemented by fine-grained quartz of Poorman "dike" is found on the south-west side.

In texture the pegmatite ranges from that of a very coarse-grained type to one in which the individual masses of quartz and feldspar have a diameter of a few inches in length. The mineralogical composition of this kind of rock varies considerably, but in general it is made up of quartz and feldspar with muscovite and some other minor minerals. The color of the "dikes" varies from a pinkish surface on the fresh portion to a dark brown appearance on the altered product made by the processes of brecciation, fracturing, silicification and weathering.

Under the microscope (Figures 11, 12 and 13), microcline is determined by the characteristic grating structure, but lacks a perfect crystal outline. An extinction angle of about 20 degrees with an index of refraction of 1.552 and the carlsbad twinning gives the composition of the plagioclase as andesine. Orthoclase is present in a smaller percentage than in the biotite granite, and has an index of refraction less than that of Canada Balsam. Sericite and kaolin, products of alteration, are developed in most of the orthoclase grains. Muscovite is colorless and shapeless and most of it is believed to be the secondary after feldspar. Quartz is next in abundance to feldspar with a feature of undulatory extinction. Some augite seems to be seen in the aplite, which is covered with particles of sericite and kaolin, that prevent an accurate determination. Apatite, epidote and magnetite are also present, but in small quantities.

The approximate mineralogical composition of a representative pegmatite determined by Rosiwal analysis is as follows:

Mineral	Percentage
Apatite	00.40
Muscovite	00.60
Augite	02.00
Epidote	03.00
Magnetite	02.00
Microcline	27.00
Orthoclase	10.00
Andesine	19.00
Quartz	36.00
Total	100.00

The approximate mineralogical composition of aplite determined by Rosiwal analysis is:

Mineral	Percentage
Apatite	00.10
Muscovite	00.40
Augite	01.30
Epidote	00.40
Magnetite	00.50
Microcline	30.00
Orthoclase	11.00
Andesine	17.00
Quartz	39.00
Total	100.00

The secondary minerals, i.e. kaolin sericite and limonite, have not been computed in these three rocks.

After a careful study of the rocks in this area, pegmatite and aplite are found to be closely related with the gneissic biotite granite, because there is some gradation found in the field. It is also noticed that some aplitic stringers inside the biotite granite have no connections with the outside. From the mineralogical composition determined, it is evident that the constituents are about the same except for difference in percentage. An explanation of their origin is that the gneissic biotite granite intruded in this region first. After a certain length of time, the upper crust solidified and fractured, but the differentiation of the lower portion still carried on to produce an acidic magma. Later volatiles of the acidic magma entered the previous fractures to form the pegmatites. Although these "dikes" of pegmatite are believed to be the same age as that of the gneissic biotite granite, they are slightly younger than biotite granite.

Figure 8. Boulder Creek Granite-Gneiss.

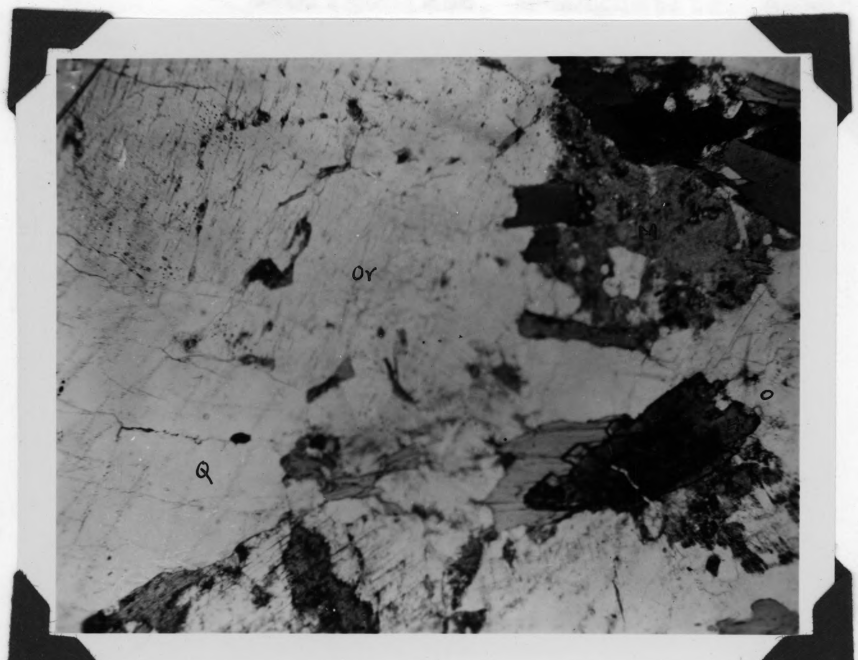

Figure 9. Microphotograph of Boulder Creek Granite-Gneiss, showing in this section under ordinary light.

X 50

H-Horneblende, Or-Orthoclase, Q-quartz
O-Oligoclase, B-Biotite, M-Magnetite.

Figure 10. Microphotograph of Boulder Creek Granite-Gneiss, showing in thin section under crossed-nicols.
X 80
K-Kaolin, Or-Orthoclase, Mi-Microcline O-Oligoclase, M-Magnetite, B-Biotite.

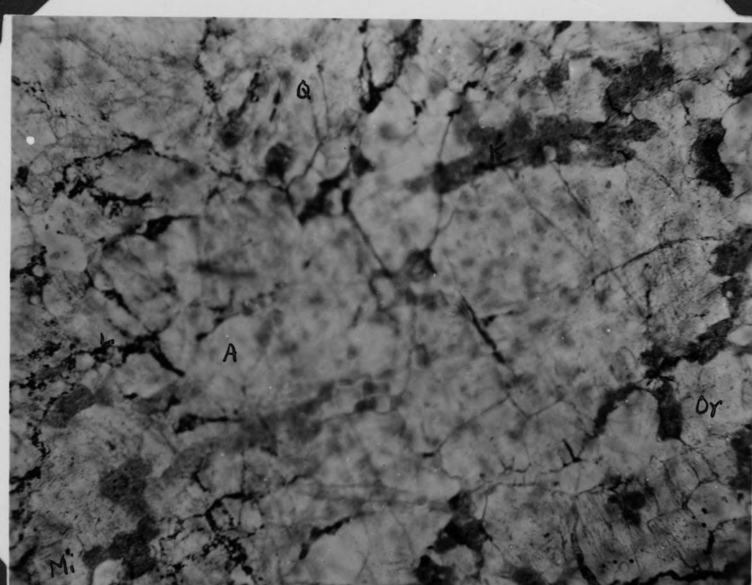

Figure 11. Microphotograph of aplite, showing in thin section under ordinary light.
X 50
L-Limonite, Quartz, Mi-Microcline, K-Kaolin, Or-Orthoclase, A-Andesine.

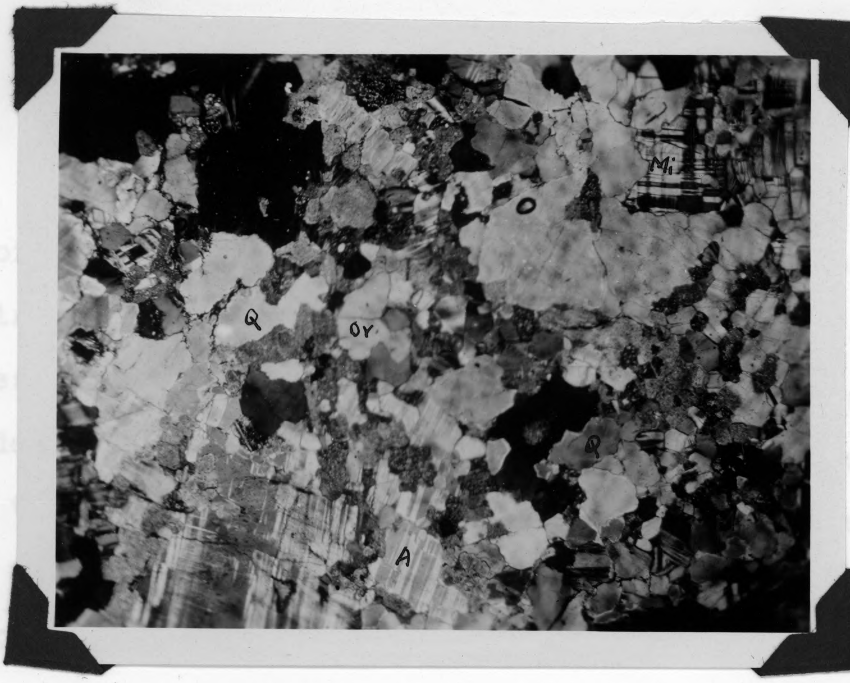

Figure 12. Microphotograph of aplite, showing in thin section under crossed-nicols.
X 50
Mi-Microcline, K-Kaolin, Q-Quartz, Or-Orthoclase, A-Andesine, M-Magnetite.

Figure 13. Microphotograph of pegmatite, showing in thin section under crossed-nicols.
X 50
A-Andesine, Or-Orthoclase, Q-Quartz, Mi-Microcline, M-Magnetite

DESCRIPTION OF THE MINE AND SUGGESTIONS FOR ITS FUTURE DEVELOPMENT

Poorman Hill deposit was formed, as generally believed, by the intrusion of pegmatitic and aplitic material along fractures of the fault zone. It has been mined for gold tellurides more than sixty years and most of the valuable ore was taken out of the top portion. On the south-west side of the hill, old surface workings can still be found, reaching average depths of two hundred feet and thereabouts. There are numerous openings, of which the important ones are described as follows:

1. The Pride Shaft - This is the first prospecting shaft in this area, sunk on the main body of Poorman "dike". Its location can still be identified.

2. The Bell Tunnel - This tunnel, with an underground shaft, is located on the north-east side of Poorman Hill. It was supposed to be a rich producer in this area about thirty years ago, but the entrance is badly caved in, making investigation impossible.

3. The Yates Tunnel - The tunnel is in good condition, but the underground water is about two to three feet deep and very little mining work has been done.

4. The Unknown Tunnel - The tunnel is about three hundred feet long, mainly following the strike of Poorman "dike" on the west side of the hill. It was operated during the last ten years. According to Mr. George Wellman,[1] once the

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(1) Personal interview with Mr. George Wellman.

lessee of the Poorman Mine, some rich ore was found there.

5. The Poorman Tunnel - This tunnel is one of the largest. It has an underground shaft about six hundred feet in depth starting from the Poorman Tunnel level (200-level) (Figures 14, 15 and 16) (Map 3) to connect the surface and four other levels at the bottom. (Map 2). The drifts are scattered in different directions covering an area of approximately six hundred square feet. Three rich veins were mined, with a middle one extending downward to the 300-level.

The ore deposits in this area do not appear to be genetically related to the pegmatitic intrusions. They are comparatively younger in age. The strike of the veins is generally east-west, more or less parallel to the strike of Poorman "dike" except for some small ones which are perpendicular to it. The idea of the early miners was that the Poorman "dike" contained ore, therefore many prospecting holes were driven across the "dike" without successful results. It seems that the Poorman "dike" acted only as an impermeable barrier which controls the trend and position of the ore solutions. Valuable ores do not exist in the "dike" itself, but they may be found in the contact planes or some distance away in the country rock. The reason is that those places are more fractured and faulted, which provided many good channelways for the ore solution to ascend. Although the Maxwell "dike" on the south-east corner of Poorman Hill does not contain any ore itself. the writer believes that it, too, acts as an impermeable barrier and prevents the ore solution from spreading to the east side of the hill, thus making the west side more favorable for mineralization.

The vein in this area is comparatively narrow and is sometimes accompanied by replacement of the country rock. Branching of the vein is common with small veinlets running into the adjoining wall rocks. Some of the branches appear to be younger, though they all have about the same composition. The average width of the vein material is about one to three inches, but the alteration products of kaolin and limonite make it appear much wider in places. The veins are a fissure-filling type, consisting of gold tellurides, silver ore and some common sulphides of lead, zinc, and iron within a black, dense quartz material . Nearly all ore bodies in this area are lenticular, localized, and of a spotty nature.

The mineralizing solution has affected the wall rock considerably. The heat of original solution was mainly responsible. The recent underground water also plays an important role in alteration.

Since the top portion of the Poorman Hill was mined out in the early days, a feasible development would be to go down below the 200-level of the Poorman Shaft. It is the writer's belief that ore solution came from below, therefore workable veins should be found, if the underground openings are driven along the contacts between the "dike" and the country rock, because they are the good places to trap the ore solution (Figure 17).

Figure 13. A view of Poorman Mine showing mine dump and old structure.

Figure 15. A view of the Portal of Poorman Tunnel

Figure 16. A view of old buildings and mine dump in front of Poorman Tunnel.

Figure 17. A photo showing the vein along the contact plane between Poorman "dike" and country rock.

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