

LODE MINING NEAR FAIRBANKS.

By THEODORE CHAPIN.

INTRODUCTION.

The occurrence of auriferous quartz veins in the vicinity of Fairbanks has been known for a number of years, but until recently quartz mining has received relatively little attention. In the last four or five years, however, considerable interest has been taken in lode prospecting. A number of producing mines are in operation and many prospects are now being opened.

The total lode production for the Fairbanks district is about \$674,000. In 1911 the production was \$64,100,¹ and about \$60,000 had been produced previously. About \$200,000 was produced in 1912. The estimate of the value of the gold-lode production in 1913, based on incomplete returns, places it at \$350,000.

In 1913 the writer spent a few days in the Fairbanks district to study the occurrence of lodes and to gather data regarding recent developments. Field work began August 10 and closed August 31. The work was planned to supplement the investigations of Philip S. Smith in 1912² and was facilitated by his previous studies. A number of the sketch maps are taken from Smith's report, with additions and corrections made necessary by recent developments.

PRESENT CONDITIONS.

The production for 1913, which was nearly double that of the previous year, in a measure reflects the progress made in quartz mining, which showed a marked advancement, particularly in development of lodes, in spite of the fact that fewer lodes were being developed and fewer men prospecting than in 1912. The rush of men to the Chisana took from Fairbanks a number of men who otherwise would have been working or prospecting for quartz lodes.

Ten plants have reached a producing stage and maintain mills of their own. Others produce considerable ore and ship it to near-by mills for treatment. Several new mills are contemplated and should be in operation before the close of the open season of 1914. Six

¹ U. S. Geol. Survey Bull. 520, p. 30, 1912.

² Smith, P. S., Lode mining near Fairbanks: U. S. Geol. Survey Bull. 542, pp. 137-202, 1913.

Hendy mills in operation in this district have a total of 23 stamps of 1,000 pounds each. There are also two Nissen mills, one 10-stamp Straub mill, one Little Giant crusher, and three small mills of local manufacture used for prospecting.

With one exception all the mills of the district use wood for fuel. As the local supply is becoming depleted the price is advancing, and at present as high as \$17.50 a cord is paid for 16-foot logs, which, when cut into cord-wood lengths, make only about two-thirds of a cord, so that in reality wood for fuel costs over \$25 a cord. At several mills the operators rather than pay this price burn stumps. At one mine alone \$20,000 a year is paid for wood used for fuel and mine timbering. A reduction on fuel costs alone would make many lodes workable which at present can not be successfully operated. One mill is run by gasoline power. No figures are available to show the comparative cost of this and the wood-burning plants, as it has been in operation for only a short time.

The stimulating effect of the proposed railroad from tidewater to the interior of Alaska has already been felt. Its actual operation should greatly reduce mining expenses.

GENERAL GEOLOGY.

The following notes on the geology of the Fairbanks district are abstracted from a report by Prindle and Katz:¹

The prevailing bedrock of the Fairbanks district is the Birch Creek schist, a series of highly metamorphosed siliceous sediments consisting of massive quartzites, quartzite schists, quartz-mica schists, hornblende schists in part amphibolitic, carbonaceous schists, crystalline limestone, altered calcareous rocks, with associated eclogitic rocks, andalusite hornfels, and a small amount of granitic gneiss derived from intrusive porphyritic granite. These rocks rest on gneissoid intrusive masses. The Birch Creek schist and included intrusive rocks inclose all the lode deposits. The beds of the Birch Creek schist are closely folded, with minor recumbent folds overturned toward the northwest. The general strike is northeast.

The igneous rocks of the Fairbanks district include several varieties of intrusive granular rocks—quartz diorite, porphyritic biotite granite, light-colored persilicic granitic dikes, and altered porphyritic dikes related to granitic and dioritic rocks. Small masses of basalt are also present.

The Birch Creek schist is regarded as probably of pre-Ordovician age. No evidence is at hand in the Fairbanks district to fix definitely the age of the intrusions. Metamorphosed porphyritic granites are thought to belong to a period of intrusion which antedates the meta-

¹ Prindle, L. M., and Katz, F. J., Detailed description of the Fairbanks district: U. S. Geol. Survey Bull. 525, pp. 50-131, 1913.

morphism of the region and to be synchronous with similar intrusive gneisses. The unmetamorphosed igneous intrusions are assigned by Prindle to the close of the Mesozoic.

ECONOMIC GEOLOGY.

GOLD DEPOSITS.

The principal gold-bearing lodes of the Fairbanks district (see Pl. XV) are fissure veins and stringer lodes. Of these the fissure veins have proved to be the principal producers of the district. The stringer lodes are composed of noncontinuous lenses and anastomosing stringers of quartz that include lenses of gouge and decomposed country rock, all more or less mineralized.

In some of the veins metallic sulphides are absent or present only in small quantities. Others contain in varying amounts the sulphides of antimony, arsenic, iron, zinc, lead, and bismuth. The sulphide-bearing veins can not easily be further subdivided according to the prevailing sulphide present, as in general one sulphide does not occur to the exclusion of the others. In one lode, however, the association of bismuth minerals and tellurium, together with the absence of other sulphides, seems to mark a distinct type. (See p. 330.)

The gold quartz lodes vary considerably in size. The fissure veins reach a maximum thickness of 15 feet, and the stringer lodes are known to be over 50 feet wide. The productive fissure veins are about 6 inches to 3 feet wide. In a small area or zone there may be a dominant strike to which most of the lodes conform, but no such condition appears to extend over the entire Fairbanks gold-lode region.

In some of the fissure veins the gold is rather evenly distributed throughout the lode. In others it is localized in ore shoots of more or less definite outline. The ore shoot can not usually be told from the leaner part of the vein except by careful sampling of the rock, for in appearance the two are identical. No change in the mineral content is apparent in passing from the ore shoot to the poorer part of the vein, but for some reason the deposition of gold was more or less confined to certain parts of the vein. One horizontal ore shoot is bounded by a fault plane, but nowhere else was it evident that the formation of the ore shoot was controlled by any structural feature. At one mine two parallel ore shoots are horizontal. Others are inclined, one pitching as steeply as 45° .

The oxidized surface portions of the veins have been enriched through residual concentration by broken-down sulphides and portions of the quartz vein removed in the process of weathering. Below the oxidized surface is a zone in which the vein has not been thus enriched and probably is fairly uniform in composition for a con-

siderable depth. Below the enriched surface zone no impoverishment in depth has been noted in the 300 feet to which mining has been carried below the surface, nor is it likely to be found at the depths which will be reached in the near future.

SILVER-LEAD DEPOSITS.

The silver-lead deposits have not become important producers, and at present none of them are opened enough to justify conclusions regarding their possible value. The known lodes of this type are composed of lead sulphide, lead sulphantimonite, and quartz. They occur as nonpersistent flat-lying bodies conforming to the foliation of the schist and appear to be replacements of calcareous bands. These deposits contain silver in notable amounts and may become of economic value if large bodies of ore are found.

MINERALOGY OF THE LODES.

The principal vein material and gangue is quartz. With it are small amounts of albite and orthoclase and associated kaolin and sericite. Calcite holds a subordinate place as a vein mineral but has been noted here and there.

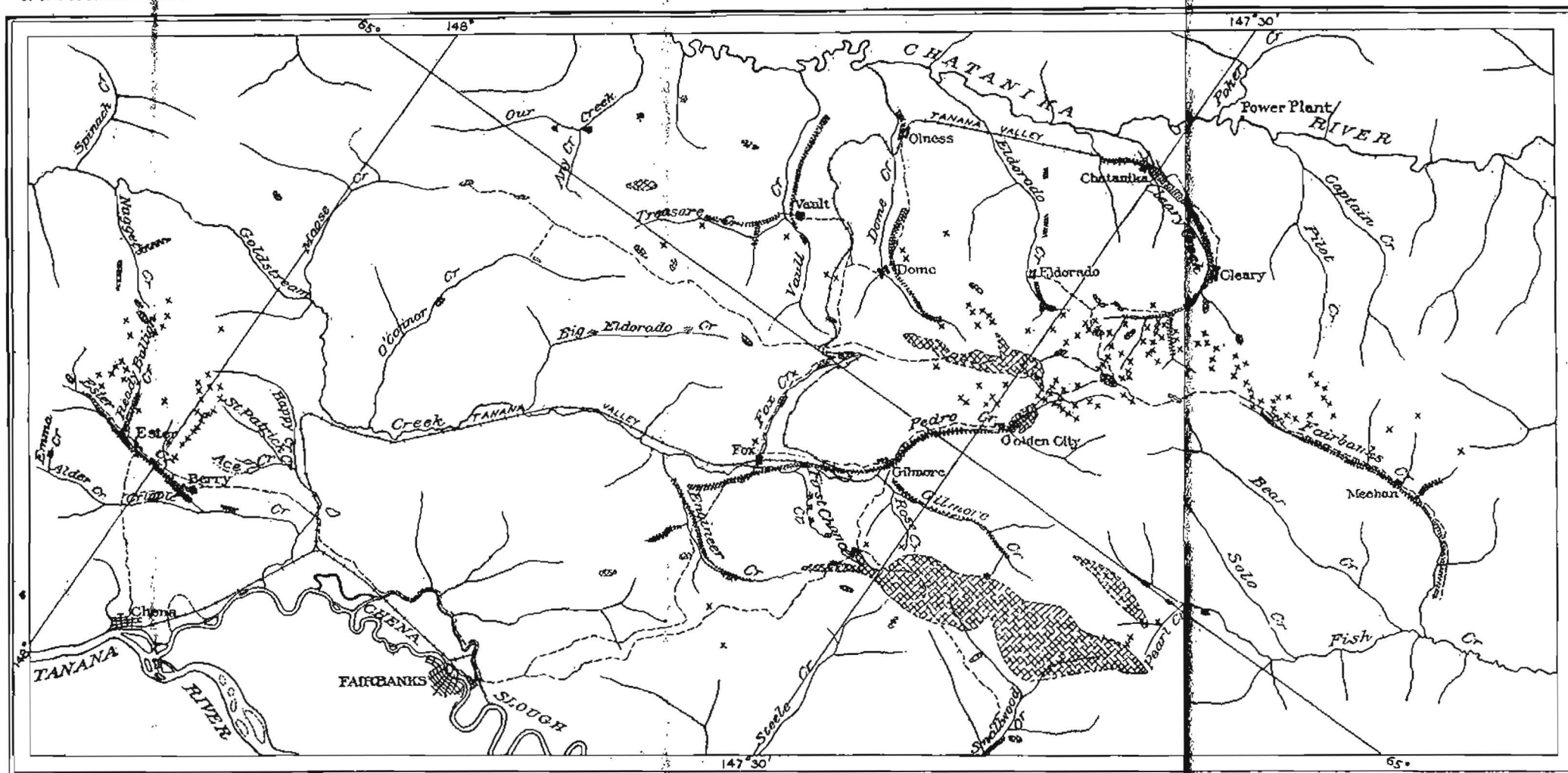
Native gold is widespread and may be seen readily in specimens from any producing lode. It occurs in small crystalline aggregates and flakes embedded in both quartz and metallic sulphides. Besides the visible gold a considerable amount occurs in combination with other elements or so finely divided as to be invisible. Silver is less abundant than gold, but is present in varying amounts in nearly all the gold-bearing lodes, although its minerals are seldom recognized. Tetrahedrite occurs on Dome Creek.¹ Locally silver is found in considerable amounts in association with galena and other lead minerals.

A number of metallic sulphides occur with the quartz. Of these stibnite is the most abundant. It occurs as acicular crystals and as both fine-grained and massive aggregates in the quartz veins. It contains a notable amount of gold.

Other sulphides associated with stibnite in considerable amounts are pyrite and arsenopyrite. The arsenopyrite resembles stibnite, but may be easily distinguished by its superior hardness. It occurs as isolated crystals and intergrown with pyrite in veins and irregular masses several inches thick.

Galena is associated with other sulphides in the gold-quartz veins and as replacement deposits in schist. It carries silver in varying amounts. Another mineral which forms a similar deposit is a sulphantimonite of lead, possibly jamesonite. Sphalerite is sparingly found in a number of places.

¹ Smith, P. S., op. cit., p. 179.



MAP SHOWING LOPE MINES AND PROSPECTS IN THE FAIRBANKS DISTRICT.

By L. M. Prindle, F. J. Katz, P. S. Smith,
and Theodore Chapin

On Melba Creek native bismuth and bismuthinite (bismuth sulphide) occur in very rich gold-bearing vein quartz. Specimens of this rock tested in the laboratory of the Geological Survey showed the presence of considerable tellurium, but its mineral association was not determined.

A few crystals of primary chalcocite and derived carbonates were seen in gold-bearing quartz veins at the Homestake mine.

A number of other secondary minerals are present. Scorodite (ferric arsenate) has formed from the alteration of pyrite and arsenopyrite. It occurs as bluish-green veinlets and as massive aggregates. Associated with the lead sulphantimonite and evidently derived from its alteration is a small amount of bindheimite (hydrous antimonate of lead). It occurs as honey-yellow incrustations of fibrous crystals. Pyromorphite (lead phosphate) and cerusite (lead carbonate) were seen at one locality in very small amounts. They occur with galena and are evidently derived by its alteration.

The alteration of stibnite has resulted in several oxides. The most common of these is cervantite, a canary-yellow mineral which occurs as pseudomorphs after acicular crystals of stibnite and also as earthy incrustations and veinlets. The yellow-green stain characteristic of the weathered portion of stibnite-bearing quartz veins is in large part due to this mineral. Stibiconite, a hydrous antimony oxide, is less abundant than cervantite. Besides the minerals noted there are various other alteration products, evidently derived from the stibnite and possibly from other sulphides. Limonitic material is plentiful. It is derived in part from the alteration of pyrite. At the Hudson mine, on Ester Creek, a coating of manganese oxide occurs on vugs in quartz veins.

Cassiterite, wolframite, hematite, and titaniferous iron ore are found in the concentrates from the placers of the Fairbanks region. Evidently their bedrock source was veins in this locality.

MINERALIZATION.

Prindle¹ considers that the mineralization bears a close relation to the intrusion of igneous rocks and that the sequence of events was as follows:

At about the close of intrusive activity, after the intrusion of dikes of granite porphyry and of persilicic granitic dikes with related veins containing a small proportion of alkali feldspar like that of the persilicic granitic dikes, there was an introduction of further products of intrusive activity in the form of solutions, in part auriferous. Through the activity of these solutions some of the dikes were sericitized, with a little alteration of iron pyrite to iron carbonate, and gold and sulphides were deposited. The occurrence of tourmaline in close association with iron pyrite and arsenopyrite at one locality seems to show one phase of the process. The facts indi-

¹ Prindle, L. M., *op. cit.*, pp. 91-92.

cate a close relation between the gold and the sulphides and the reference of both to a genetic relationship with the igneous rocks.

But, as has been pointed out by Prindle, it does not necessarily follow that the areas near the exposures of igneous rocks are the places where lodes are most likely to be found, for it is probable that deformation at the time of intrusion facilitates the transportation of material from the magma, and conditions favorable for solution may be maintained so long that gold derived from this source is carried in solution far into the surrounding rocks before reaching areas where conditions favorable for deposition prevail. Moreover, areas where no outcrops of igneous rocks occur may nevertheless be underlain by such rocks, which are mantled by a thin covering of schist.

The metallization is thus regarded by Prindle as occurring near the end of the Mesozoic era. As has been suggested, however, there appears to be no evidence that it was not in part, at least, early Tertiary.

LODE MINES AND PROSPECTS.

FAIRBANKS CREEK VALLEY.

EAST OF MOOSE CREEK.

Between the forks of Alder Creek at an elevation of about 2,100 feet is the McCarthy claim (see fig. 4), located on a vertical vein of quartz 12 to 15 feet in width. The vein, which strikes about N. 40° E., has been opened by a tunnel for 160 feet, and a number of cross-cuts have been made across the vein to determine its extent. The vein material is opaque quartz with large horses of schist. The vein is fractured and refilled in places, but apparently there has been little sulphide mineralization. Assessment work has been done each year, but no work was in progress at the time of visit in 1913.

On the ridge between Alder and Crane creeks, at an elevation of 1,950 feet, a quartz vein is being prospected on the Queen claim. The present developments consist of a short shaft and a 100-foot incline. About 30 feet from the top of the incline the vein is 18 inches wide, but at this place the vein is cut off by a fault striking N. 70° W. and dipping 33° NE., which cuts the vein at a low angle, so this is probably not the full width of the ore body. The incline follows this fault, which evidently was mistaken for the footwall of the vein. The lower portion of the incline was inaccessible, but it is reported that the vein was followed for a distance of 100 feet. The property consists of this and several adjoining claims extending from Alder Creek to a point near the mouth of Crane Creek. No work was in progress at the time of visit, but operations were being planned by the owners for the coming winter.

MOOSE CREEK.

Considerable work had been done on Moose Creek, principally by Crites & Feldman, who have developed their property to a producing

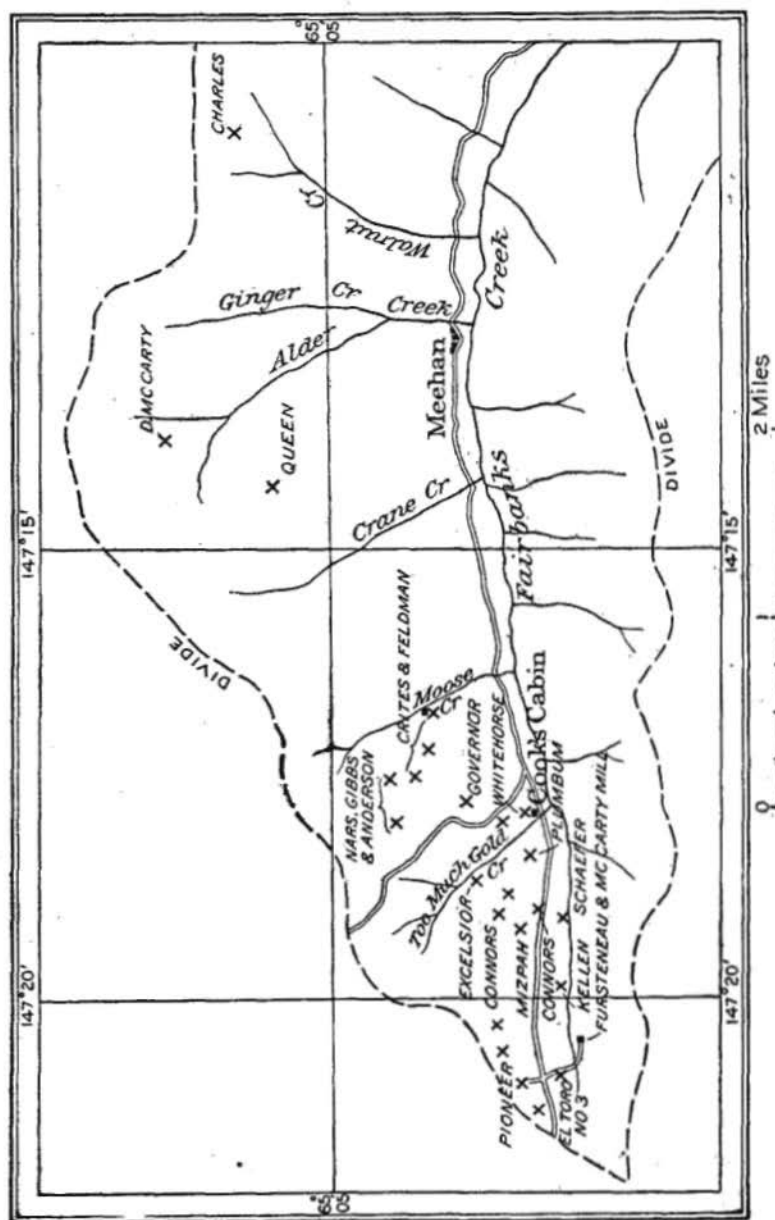


FIGURE 4.—Sketch map showing location of lode prospects in Fairbanks Creek valley.

stage. The main development work consists of a tunnel 450 feet long, which has been driven along the main vein in a northwesterly direction. At a point 350 feet from the mouth of the tunnel the

vein was offset by a nearly vertical fault but was found by a short drift along the fault plane toward the north. About 250 feet from its mouth this tunnel is connected with the surface by an inclined raise of 65 feet along the vein.

The veins have been traced from a point near the creek to the ridge between Moose and Too Much Gold creeks, a distance of two claim lengths, by prospect pits and trenches. Several veins are evident, but not enough work has been done to determine their relations. They have a general northwesterly direction but are not parallel.

Although the entire length of the tunnel is in ore, considerable variation of the gold content is evident from place to place. Portions of the vein where sulphides are the most abundant form richer zones, and although not sharply differentiated from the leaner parts of the vein, these zones, which are roughly parallel, have impressed upon the vein a rude structure dipping into the hill. It was noticed by the miners in driving the tunnel that rich ore was first encountered in the roof.

Enrichment of the surface material by oxidation is pronounced in places. The upper tunnel for 150 feet from its mouth is in the oxidized zone. From this portion of the tunnel 23 tons of ore yielded an average of \$130 a ton, and the vein is known to be equally rich in a number of places on the surface. Two assays show a fineness of 0.857 and 0.850 for gold and 0.133 and 0.140 for silver, indicating an average value of about \$17.72 an ounce.

At the time of visit work was confined principally to surface trenching of the rich portions of the vein. At present the ore is hand picked and hauled to a near-by mill for treatment, but the owners plan to install a mill on the property in the near future.

Adjoining the property of Crites & Feldman is the Teddy R claim, on which a tunnel has been driven for 150 feet along a ledge of gold-bearing quartz. Considerable ore has been shipped from this claim, and at present the owner is at work developing the lode.

TOO MUCH GOLD CREEK.

Development work was continued on the property of Nars, Anderson & Gibbs on Too Much Gold Creek. Some difficulty was experienced with foul air, considered to be due to the arsenical iron in the ore, and work in the lower part of the shaft was abandoned. This trouble is now remedied by a raise to the surface from the west drift on the 60-foot level, which has provided an adequate circulation of air to ventilate the lower workings.

At the time of visit in 1913 work was temporarily discontinued, but operations were being planned for the coming winter. A small test mill with one 50-pound stamp, which is increased to about 150-pound

efficiency by the use of additional weights and a spring, is used for sampling ore. It is planned to do more development work before installing a larger mill.

A number of other prospects have been opened on Too Much Gold Creek, and from some of them shipments of ore have been made. Little work, however, was done in 1913, and at the time of visit no work was in progress.

WEST OF TOO MUCH GOLD CREEK.

Development work has been continued on the Mizpah claim, which is situated on Fairbanks Creek half a mile east of the mouth of Too Much Gold Creek. This claim is being developed on a near-by vertical eastward-trending quartz vein. The vein has been opened to a depth of 120 feet by a shaft and drifts turned off at the 80-foot level.

The Ohio and Mayflower claims are being opened by Connors & Stevens. Some development work was done in 1913, but at the time of visit neither of the workings was accessible.

Northwest of the Mizpah claim, at an elevation of 1,980 feet, George Perrault has located the Minnie and Aroostook claims and made a surface opening on a ledge striking N. 80° W. and dipping 60° S. At the time of visit the workings were caved and could not be adequately examined. The ledge consists of three or four nearly parallel veins of quartz inclosing masses of schist, all more or less mineralized. Limonitic material taken from the dump is said to occur in veinlike formation parallel to the quartz vein and to contain small amounts of both gold and silver. Narrow reticulating veinlets of stibnite occur in both quartz and schist, and a yellow-green stain of antimony oxide is abundant.

Near the head of Fairbanks Creek are a number of other claims which were not visited in 1913, as none were in operation and little if any recent work has been done. Some have proved to be valueless and others are involved in litigation.

UPPER FISH CREEK VALLEY.

PEARL CREEK.

On the upper tributaries of Fish Creek several promising lodes are being exploited. (See fig. 5.) The greatest amount of work has been done by Perrault & Murphy on a group of claims near the divide between Pearl and Smallwood creeks. On the American claim an inclined shaft was driven 60 feet along a mass of quartz said to strike N. 50° E. and dip 60° NW. At the time of visit the lower workings were flooded and the shaft was timbered, so the relations could not be studied. The ore body is described as a very irregular mass of quartz ranging in thickness from 6 inches to 3½ feet. Ore on the dump

is principally white glassy quartz with few sulphides. Examination of thin sections of the rock shows the quartz to contain fragments of quartzite and schist partly replaced by the vein and altered to chloritic matter. A second injection of quartz is shown by veinlets which cut the main lode. Specimens of black quartzite breccia cemented with white glassy quartz are said to come from the upper part of the vein, which for a depth of 9 feet is made up of this rock. This appears to be a bed of quartzite schist which did not admit of a clean-cut, open fracture in the process of vein formation but instead was brecciated. The tendency of a strong vein to split into stringers when it traverses quartzite beds has been noted in other places in this region.

The footwall of the quartz body is a zone of schist about 3 feet wide, mineralized with small stringers of quartz. Very little gold is

visible in the hand specimens, but gold may be panned from nearly any sample of the vein taken at random. At the time of visit in 1913 plans were being made for the erection of a mill in the near future.

Michael Stepovich is prospecting a lode adjoining the Perrault & Murphy property on the southwest and has sunk a shaft 38 feet deep on a vein of quartz striking N. 70° E. and dipping

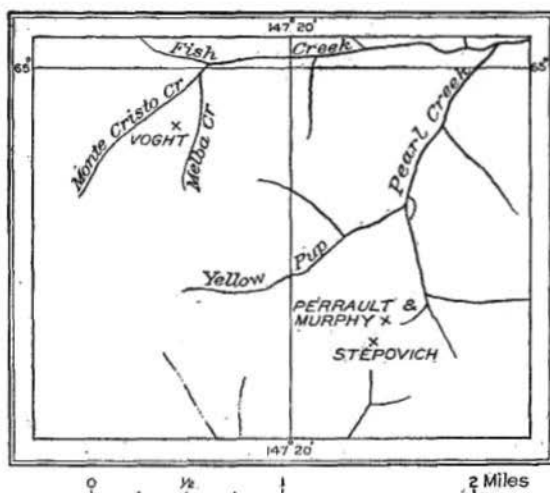


FIGURE 5.—Sketch map showing location of lode prospects in upper part of Fish Creek valley.

70° NW. At the time of visit no work was in progress and the shaft was inaccessible, but pieces of ore on the dump showed the vein to be mainly white milky quartz similar in appearance to that on the adjoining property. In the quartz vein are bunches composed essentially of arsenopyrite but containing a little pyrite. Fractures in the sulphide masses are cemented by veinlets of scorodite derived from the alteration of the iron and arsenic minerals.

MELBA CREEK.

On the ridge between Melba and Monte Cristo creeks, tributaries of Fish Creek near its head, a bismuth-bearing gold quartz vein is being prospected by Edward Voght. An opening made on the vein was

inaccessible at the time of visit, but samples taken from the surface exposure show the vein to be mainly quartz carrying a small amount of intergrown native bismuth and bismuth sulphide. The vein, which is said to be about 5 inches thick, stands nearly vertical, trends east, and cuts fine-grained biotite granite. In the specimens collected particles of visible gold are plentiful, embedded in the bismuth minerals or in the quartz. Determinations made in the laboratory of the Geological Survey show the presence of tellurium. The mineral in which it occurs was not determined.

CLEARY CREEK VALLEY.

WOLF CREEK VALLEY.

PENNSYLVANIA MINE.

The Pennsylvania mine is situated on Wolf Creek near the Fairbanks divide, at an elevation of 2,100 feet. (See fig. 6.) The underground development consists of an inclined shaft 146 feet deep, 20-foot drifts east and west on the 50-foot level, and several raises, one of which connects with the surface. A Little Giant mill with a capacity of 8 tons of ore a day was built last October near the head of Fairbanks Creek, half a mile from the mine. Over 100 tons of ore has been milled from the Pennsylvania and other properties. Water for milling is obtained from Fairbanks Creek and for short runs the supply has proved plentiful. Neither the mill nor the mine was in operation at the time of the writer's visit in 1913, and the underground workings were not examined.

No fair tests have been made to determine the actual tenor of the ore, for mill tests made in Fairbanks, which yielded very high returns, were made on selected material, and the only ore treated in the mill near the mine was waste from which the high-grade material had been picked for shipment. More rock must be milled before the value can be determined. No production was made in 1913.

HOMESTAKE MINE.

The Homestake mine is situated near the head of Wolf Creek at an elevation of about 1,500 feet. The property was located by August Balzimer in 1908, has been intermittently worked by the Homestake Mining Co., and in the spring of 1913 was leased to George Nightingale.

Several veins, all having a general easterly trend, were traced on the surface and a development tunnel was driven southward to intersect them at depth. The greatest amount of work has been done on a vein striking east and dipping 45° S., intersected by the tunnel 320 feet from its mouth. At this point the vein is barren, but a short drift extending westward for 50 feet along the vein revealed a pocket

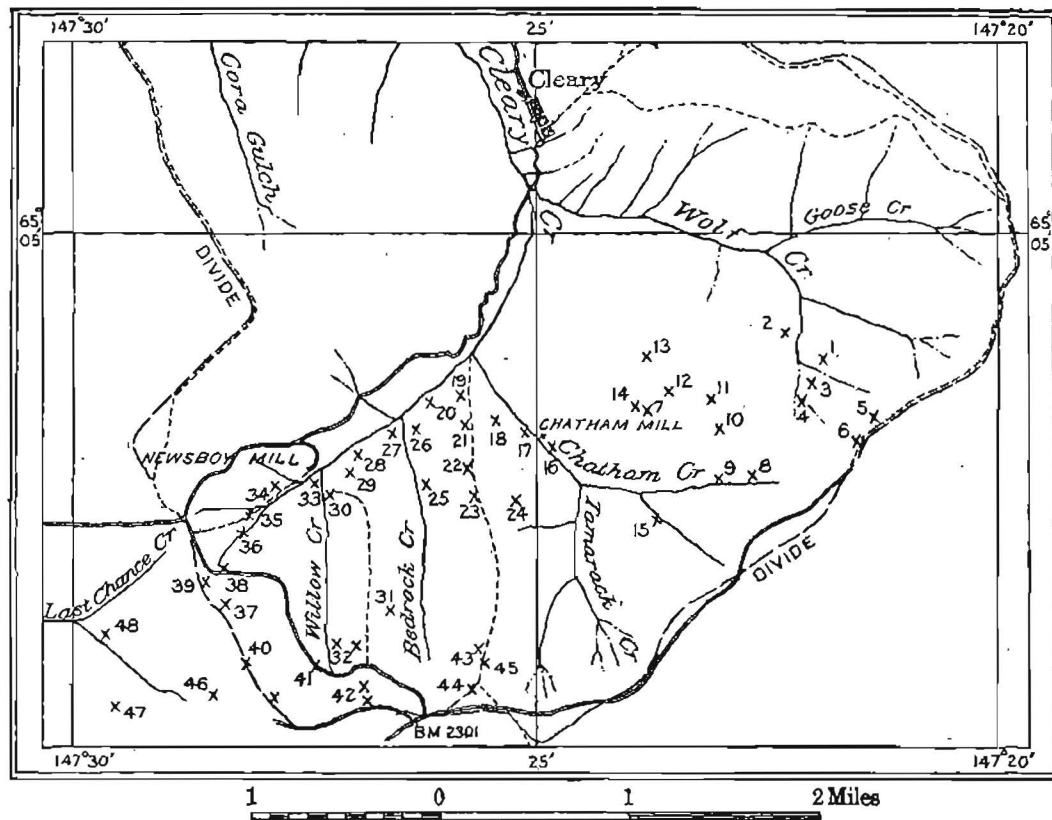


FIGURE 6.—Sketch map showing location of lode prospects in upper part of Cleary and Eldorado Creek valleys.

1. Banner.
2. Solomon.
3. Rexall.
4. Homestake.
5. Pennsylvania.
6. Dorothy.
7. Empiro.
- 8-9. Chatham Mining Co.
10. Harris & Brown.
11. Quamboe Bros.
12. Furstensen.
13. Quamboe Bros.
14. Jupiter Mars.
15. Roughneck.
16. Pioneer.
17. Rex.
18. B.-P.
19. Cunningham.
20. Lyoma.
21. California.
22. Pauper's Dream.
23. Alabama.
24. Bobbie.
25. Wyoming.
26. Rhoda Hall.
27. Stepovich.
28. Cresscut.
29. Tolovana Stibnite.
30. Tolovana.
31. Hess & Burnat.
32. Emma.
33. Stibnite.
34. Schuyemere.
35. Eldorado.
36. Steel.
37. Sunrise.
38. Newsboy Extension.
39. Newsboy.
40. (?)
41. Cornell.
42. Cheyenne.
43. Your Jim.
44. Jackson.
45. Silver King.
46. Rose.
47. Thompson.
48. Hidden Treasure.

of very rich ore. The most work has been done east of the tunnel. A drift has been opened along the vein for 300 feet and a number of stopes worked out, roughly outlining two ore shoots separated by barren portions of the vein. At the west end of the drift the vein is low in gold content, but eastward from a point 90 feet from the main tunnel the floor of the drift is in ore for 160 feet. Beyond to the end of the drift, a distance of 50 feet, the vein is barren and split up into stringers. The downward extension of the ore shoot has not been

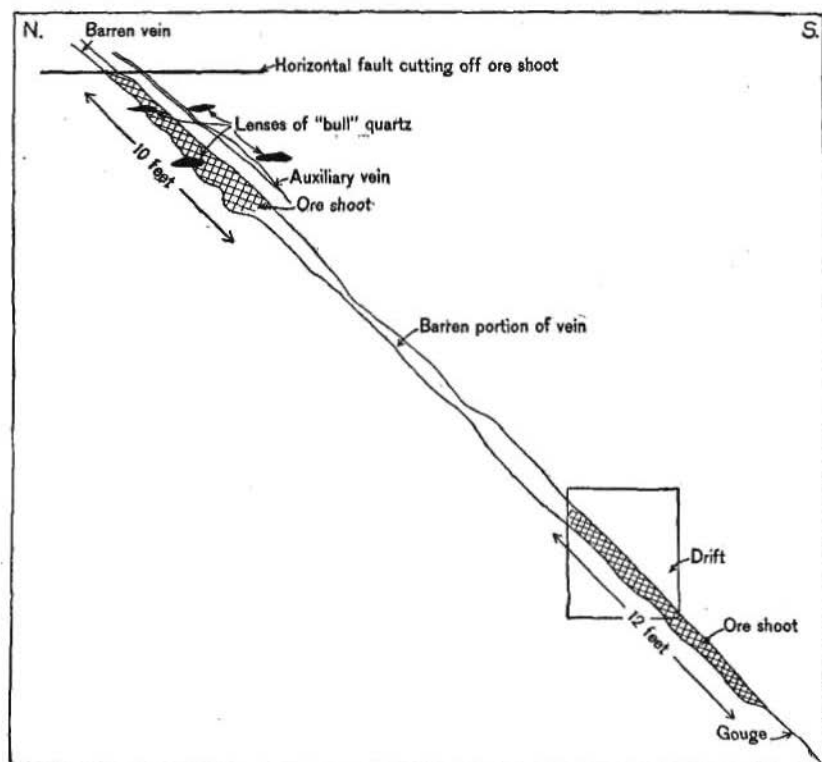


FIGURE 7.—Cross section of lode in east drift of Homestake mine, showing relation of ore shoots.

determined except at one point where an incline along the vein for 8 feet showed the vein to pinch out. (See fig. 7.)

At a point 135 feet from the mouth of the drift a 150-foot raise to the surface shows the vein to be continuous, although much of it is barren of gold. This raise intersects another ore shoot 30 feet above the lower one, bounded on its upper limit by a horizontal fault with no apparent displacement of the vein, indicating a movement parallel in direction to the strike of the vein. Striae indicate the same relative direction of movement. Much of the upper ore shoot has been stoped out, proving a length of at least 100 feet. This ore shoot,

which is about 10 feet thick, has a nearly horizontal pitch. The vein is from 3 inches to a foot wide and averages about 9 inches.

The barren portions of the vein between the ore shoots differ but little in general appearance from the productive parts, which can be determined only by sampling. Lenses of "bull" quartz in the country rock appear to be more abundant adjacent to the ore shoots than along the leaner portions of the vein, and this association is said to be so general that when drifting along a vein the miners interpret an abundance of quartz lenses in the country rock as evidence of a rich portion of the vein. Some of the lenses of quartz that are cut by veins are mineralized and are hard to distinguish from the later vein quartz.

The main tunnel has been driven for 750 feet and has cut three other small veins. One near the mouth dips steeply to the north. About 600 feet from the mouth of the tunnel a quartz vein striking N. 60° W. and dipping 45° NE. was cut and drifted along for 100 feet. It averages a foot in width but locally widens and narrows. At the face of the drift it pinches to a gouge seam. Movement has occurred along the walls of the vein, and in one place the vein is faulted with small displacement. At the face of the tunnel is a stringer vein dipping south.

The vein matter is composed of iron-stained crystalline quartz with many open spaces. Sulphides are not abundant. Stibnite forms in isolated bunches in the vein, and pyrite and chalcocite, the black sulphide of copper, occur sparingly. Specimens taken from the dump show a parallel intergrowth of quartz and bladed crystals of chalcocite, giving the vein a granitic texture. Associated with the chalcocite are blue and green incrustations of copper carbonate, and throughout the vein are vugs and veinlets of limonite, oxidation products of the original vein minerals. The microscope shows a minute system of parallel fractures in the quartz resembling cleavage. Portions of the vein containing the copper minerals are said to be the richest in gold. Particles of visible gold occur in the quartz but are not numerous.

The localization of the gold in high-grade ore shoots, if such ore bodies are carefully delimited, makes milling costs less than if the same amount of gold were uniformly distributed throughout the vein.

REXALL MINE.

The Rexall mine, adjoining the property of the Homestake Mining Co., is being developed by Horton & Solomon. It was located in 1910 on a 5-foot quartz vein striking N. 25° E. and dipping about 25° NW. A tunnel was driven along the vein for 140 feet to an intersecting east-west vein, to the development of which subsequent

work has been confined. A drift has been carried for 500 feet along this vein, giving a back of ore of 175 feet. Several upraises and winzes have been opened, blocking out stopes of ore, some of which have been worked out.

The vein material is essentially quartz with few sulphides. Along the hanging wall of the smaller vein, which is 12 to 18 inches thick, is an inch or more of gouge, and associated with it are narrow gash veins—lenses of quartz connected by veins of gouge.

A Joshua Hendy mill was installed in the fall of 1912. The mill has two stamps of 1,000 pounds each, with an 8-inch drop, and is equipped with a Blake crusher. The ore is trammed from the workings to the ore bins and automatically fed. An Otto gasoline engine furnishes power to run the mill and to pump 1,000 gallons of water an hour for the mill, at an expense of \$14 each 24 hours for gasoline and cylinder oil. This is the only mill in the district that uses gasoline for fuel, and its comparative efficiency is being watched with interest by other operators. Water for the mill is pumped from a well beneath the engine room.

CHATHAM CREEK VALLEY.

CHATHAM MINE.

The Chatham mine, near the head of Chatham Creek, is on a vein averaging 6 to 18 inches wide, which, previous to underground work, was prospected by surface pits for a distance of 500 feet. The vein, which is located on the north slope of the valley, strikes N. 60° W., nearly parallel to the contour of the hill, and dips 65°–80° SW. A development tunnel 203 feet long cuts the vein about 95 feet below the surface, and from this point drifts 400 and 500 feet long have been driven northwest and southeast, respectively, along the vein. Raises were started every 35 feet and several have been extended to the surface, blocking out stopes of ore. Eastward for a distance of over 400 feet from a point 175 feet west of the face of the main tunnel nearly all the ledge from the main drifts to the surface has been taken out. The ore is extracted by stoping upward from the drifts and shooting the rock down.

The vein material is essentially quartz with low sulphide content. Wherever examined it was from 6 to 18 inches wide, but along the surface for a short distance in a portion now mined out the vein is said to have been only a seam of gouge. A narrow vein of stibnite striking east and dipping south cuts the main vein in the east drift about 150 feet from the main tunnel. East of this stibnite vein for about 200 feet, midway between the drift and the surface, a rich

shoot of ore occurring in a horizontal lenticular mass was mined out. Its association with the stibnite vein suggests a relationship, although no enrichment of the quartz vein was noted along the intersection of the two veins at other places.

Movement parallel to the strike of the vein has produced horizontal striations along the walls but has not involved the vein to any great extent, although one displacement of 16 feet occurs along an east-west fault which cuts the vein on the west drift about 200 feet from the tunnel.

Although the value of the ore varies from place to place, no very rich bonanzas are known to occur in the vein, but considerable bodies of paying ore showing nearly uniform tenor have been blocked out, and the vein as far as worked has had few barren portions, so that practically all the rock mined can be milled. The downward extension of the ore body has not been determined.

The ore is trammed from the workings and temporarily placed in ore bins near the mine and taken to the mill by a downhill wagon haul of over a mile. From the ore bins at the mill it is automatically fed into the hoppers and crushed to pass a 40-mesh screen before flowing over the plates. The mill is a Joshua Hendy, equipped with two batteries of 1,000-pound stamps each. A 6-foot riffle box and double amalgam traps are used to catch any gold that passes the plates.

PIONEER MINE.

The Pioneer mine is located on Chatham Creek a quarter of a mile below the mouth of Tamarack Creek. The property was located as the Blue Bell lode in 1903, but little work was done until 1908, when it was developed. The property was not examined in 1913, for the mine was not in operation and the underground workings were inaccessible.

Since the completion of the mill in the fall of 1912 the Pioneer Mining Co. has milled 200 tons of its own ore besides considerable ore from other properties. The mill is a Joshua Hendy and has five 1,000-pound stamps, dropping 100 times a minute. The ore is trammed 300 feet to the mill, where the fines are automatically fed into the hopper and the coarser material is shoveled into the crusher. The pulp flows over two 10-foot amalgam plates placed tandem, giving a plate surface 20 feet long. An amalgam trap and auxiliary riffles fitted with cocoa matting are used but are said to be unnecessary. Assays on the tailings show them to contain from 50 cents to \$3 a ton. No concentrator is used. Water for the mill is obtained in summer from Chatham Creek and in winter is pumped from an abandoned shaft which serves the purpose of a well.

OTHER PROPERTIES.

On the Gladstone claim, one of a group belonging to the Jupiter-Mars Consolidated Mining Co., situated half a mile northeast of the Pioneer mine, at an elevation of 1,700 feet, some ore has been produced, but no work was in progress in 1913 and the workings were inaccessible. Two tunnels were driven to open a flat-lying vein which dips south into the hill. East of the tunnel a shaft was sunk 125 feet to the vein and 112 feet of drifts turned off. The ore was treated at the Pioneer mill.

A small production of ore is reported from the Empire group of claims, adjoining the Jupiter-Mars property. Last winter a lease was taken on four claims of this group by Foster & Hungerford, who took out 14 tons of ore. No work was in progress at the time of visit in 1913, and the prospect was not examined.

On the Sunrise claim, at the junction of Cleary and Chatham creeks, a vein trending east and dipping 25° S. has been prospected by several open cuts and an adit that cuts the vein at a point 25 feet from the mouth of the opening, where a short drift was turned off to the west. The lode is about a foot thick and is composed of ribbons of rusty-looking quartz with wide seams of blue gouge and included lenses of schist. Fresh breaks show the quartz to be opaque and dull, and no sulphides are apparent in the vein material. Cavities in the quartz are filled with limonite. On the dump are specimens of quartz impregnated with stibnite and containing veinlets and coatings of antimony oxide, different from any rock seen in the vein. The face of the inclined adit was flooded with water so that the opening was inaccessible 30 feet from the mouth.

BEDROCK CREEK VALLEY.

RHODES-HALL MINE.

Active work has been continued on the Rhodes-Hall property, which continues to be the principal producer of the district. The vein is composed essentially of quartz with few sulphides and averages about 12 inches in width. The mine has been developed by three adits, which with underground connections, drifts, and cross-cuts represent over 3,000 feet of work. The main tunnel has been driven along the vein for 1,280 feet, and about 500 feet of auxiliary openings has been made. From this adit an inclined shaft was sunk along the vein for 112 feet, and at the 70-foot level and at the bottom of the incline drifts were turned off aggregating nearly 1,000 feet in length. The Penrose tunnel has opened the vein for 280 feet. It is 140 feet above the main tunnel and is connected with it by a 160-foot winze. Much of the ore included between these two tunnels has been taken out.

Last October an electric pump was installed to remove the water which collects on the lower levels. It is operated continually and pumps over 50,000 gallons a day. The water thus obtained is used in the mill but is unsatisfactory, as the scale which it forms on the boilers and heaters is very troublesome.

TANANA QUARTZ & HYDRAULIC MINING CO.'S CLAIMS.

A group of claims belonging to the Tanana Quartz & Hydraulic Mining Co. and located on Bedrock Creek south of the Rhodes-Hall property is being worked by Antone Goessmann. The location of the claims was made on a north-south vein and two nearly parallel ones striking N. 75° W., which have been opened in a number of places.

In the summer of 1913 work on this property was confined to surface trenching of the richer portions of the veins. This serves the double purpose of prospecting the lead and producing high-grade ore for shipment. The method of working is to uncover the vein along the surface and to sample it constantly by crushing the rock and panning it to determine the gold content. The richer portions thus determined are taken out to a depth of about 10 feet and are hand picked and sacked ready for shipment. The rejected rock is stored for future treatment in case a mill is installed on the property or facilities are provided for treating lower-grade ore. A shipment of 4½ tons of ore was treated at the Pioneer mill and another lot of 4 tons was ready for shipment in August, 1913.

JACKSON CLAIMS.

The Jackson lodes are located on the ridge between Bedrock and Tamarack creeks, about a quarter of a mile northwest of bench mark 2301. On the Silver King claim a shallow opening has exposed a flat-lying lode about a foot thick, parallel to the foliation of the schist. The lode is bordered by ribbons of quartz with stringers of pyrite, arsenopyrite, and derived products. The center is composed essentially of sulphantimonite of lead. Tests made on this mineral showed it to carry considerable silver. Small masses of associated pyrite and arsenopyrite have been largely altered to scorodite.

On the Your Jim and Our Jim claims, a short distance below the open cut on the Silver King claim, a prospect tunnel has been driven 428 feet in quartzite schist. About 70 feet from the mouth the tunnel cut a quartz stringer which contains gold and silver. The tunnel also cut a series of nearly east-west parallel faults that dip steeply to the south. Narrow seams of gouge along the fault planes are said to contain considerable gold. A zone of crushed quartz and blue gouge bordering a fault 300 feet from the mouth of the tunnel contains heavy concentrates but no free gold.

On the east side of the ridge between Willow and Bedrock creeks, near the crest, at an elevation of 2,025 feet, some work has been done on a lode supposed to be the same vein that is being opened on the Emma claim. A shaft sunk by Hess & Burnett last winter was flooded and inaccessible, and no information regarding the deposit was procured. On the dump were pieces of quartz containing stibnite and considerable pyrite and limonitic material.

WILLOW CREEK VALLEY.

TOLOVANA MINE.

The Tolovana mine is on Willow Creek about 300 yards from the mouth. The main development work has been done on an eastward-trending vein which dips 60° S. A short distance above the mill the vein has been opened by a tunnel which has been driven eastward along the vein for a distance of 330 feet and by a number of short crosscuts. Two inclines sunk along the vein—one a shaft at the mouth of the tunnel and the other a winze 95 feet from the mouth—are connected at the 100-foot level by a drift, and the block of ore between these openings, 9,500 square feet in area, has been taken out and milled. Another drift was extended eastward from the eastern winze along the vein on the 50-foot level and a short winze was started at the eastern face of the drift. Considerable ore has been stoped out above the workings of the main tunnel and the 50-foot level.

The lode is composed of stringers of quartz inclosing lenses of schist. The quartz is dull and opaque and contains few open cavities. The gold is native but appears to be associated with the stibnite that occurs scattered through the vein in needle-like forms. The quartz stringers are frozen to the country rock, and the rock mined and milled as ore therefore contains besides the quartz the included mineralized masses of schist and considerable wall rock, all more or less impregnated with gold-bearing sulphides.

Northeast of the Tolovana mill, on the Tolovana-Stibnite claim, another stibnite-bearing vein has recently been prospected. A shaft was sunk on an eastward-trending vein for 100 feet, and at the 50-foot level drifts were turned off to the east and west for 50 and 30 feet, respectively. A raise 24 feet west of the shaft connects the 50-foot level and the surface, and the block of ore thus outlined has been stoped out and milled. No further work has been done on this property, although the amount of gold obtained in the mill run shows the lode to be workable ore. The vein is composed of quartz with considerable stibnite and lesser amounts of other sulphides. Yellow antimony oxide, in places stained red and brown by mixtures of other alteration products, is common.

The most promising vein on the property is one recently uncovered and at the time of visit just being opened. The vein strikes east and the surface dips 50° S. It is nearly parallel to the main vein in the mine. It is being opened by a shaft from which drifts will be driven east and west to prospect the vein, and if results warrant it a crosscut will be run from the mine. The lode is a strong vein of quartz from 18 inches to 3 feet wide with two well-defined walls separated from the vein by gouge seams. It thus differs notably from the stringer lode exposed in the mine.

The surface outcrops show considerable stibnite occurring as irregular veinlets and masses consisting of needle-like crystals. Particles of visible gold are common in both stibnite and quartz. Assays on the surface portion, considered by the operators to be a fair sample of the vein, showed a high gold content.

In September, 1912, a 2-stamp Nissen mill replaced the Huntington mill originally used and was run for two months. Since that time it has been used only for making test runs, but it is hoped that the opening of the recently discovered vein will furnish a constant supply of ore, so that the mill can be run continuously.

EMMA CLAIM.

The Emma claim is on the east side of Willow Creek, near the head, at an elevation of 2,100 feet. An east-west vein has been opened by an inclined shaft 60 feet deep, from which drifts 30 and 70 feet long have been turned off to the east and west, respectively. On the surface the vein dips 60° S., but in depth it flattens to 45° . The vein where exposed in the workings is composed of 4 to 12 inches of quartz with well-defined walls and thin gouge and separates readily from the inclosing rock. Fine particles of visible gold appear in specimens of the ore. The vein has been traced by surface pits for several hundred feet, and near the creek an opening was made, which is now caved in. Another tunnel is being driven to crosscut the vein and connect with the underground workings, thus prospecting the lode for a considerable distance and providing an adit for the removal of ore.

CLEARY CREEK ABOVE WILLOW CREEK.

NEWSBOY MINE.

A quarter of a mile south of the saddle between the heads of Cleary and Last Chance creeks the Newsboy mine is being developed on a vein that trends about northeast and dips 73° NW. The underground development consists of an inclined shaft parallel to the vein, drifts on the 60, 115, 150, 215, and 315 foot levels, and connecting winzes and stopes. A largestope extends northeastward from the shaft for 75 feet and is connected with the lower level by a winze, blocking out a quantity of ore.

The 115-foot level extends 140 feet southwest and 100 feet northeast of the shaft, and much of the ore between it and the 150-foot level has been taken out. A few feet east of the shaft the vein splits into two large branches and a number of smaller ones inclosing considerable schist. At this place the vein reaches a thickness of 14 feet. The entire ledge including the schist horses is mineralized, and all the rock taken out is milled.

The 150-foot level has been driven 200 feet northeast and 140 feet southwest of the shaft.

On the 215-foot level drifts extend 225 feet southwest and 175 feet northeast. Northeast of the shaft this level is connected with the upper level by several winzes, blocking out a number of sections of ore.

No work was being done on the 315-foot level at the time of visit. About 250 feet of drifts have been turned off, but they are flooded with water and inaccessible. This level is now used as a reservoir. All seepage water from the mine is allowed to collect there and is pumped out as needed during the winter. Water for summer use is obtained from a spring near by.

A 5-stamp Hendy mill was installed at the mine in the fall of 1911 and for the first year was run with water pumped from the mine, but this supply proved inadequate, so the mill was moved. It now stands 600 feet below the mine, on the north bank of Cleary Creek, on placer claim "No. 11 above." Water for the mill is pumped from a well near the present site. The ore is brought from the mine by wagons, a distance of nearly a mile. It is planned to drive a tunnel from a point near the present site of the mill along the vein on the 600-foot level and eventually to connect with the present workings. This would determine the continuity and gold content of the ledge and reduce operating expenses by lessening a long wagon haul and the power necessary to lift ore to the surface.

The vein is composed of dull granular quartz and contains a large amount of sulphides. It varies in width from a few inches to 14 feet and includes many horses of schist. The tenor of the ore mined varies considerably, depending in large part on the amount of included wall rocks.

OTHER PROPERTIES.

The Newsboy Extension mine has not been operated for some years and the underground workings are flooded.

A group of claims on the ridge between the heads of Willow and Cleary creeks, south of the road leading to the Newsboy mine, at an elevation of 2,400 feet, has been prospected by a number of openings. An old tunnel and shaft were both caved, and pits recently opened were filled with water, so that little could be learned of the relations. Pieces of quartz on the dumps showed little or no sulphide mineralization.

ELDORADO CREEK VALLEY.

On the headwaters of the various branches of Last Chance Creek, the main tributary of Eldorado Creek, a little prospecting has shown the presence of a number of gold-bearing lodes.

The Sunrise claim, east of the Newsboy mine, at an elevation of 1,975 feet, has been prospected by a number of surface pits. The openings could not be examined in 1913 on account of the dirt and water which had accumulated. On the dumps were fragments of quartz which apparently occurs in narrow stringers in the schist.

About a quarter of a mile south of the Newsboy shaft, at an elevation of 2,100 feet, is the Rose claim, which has been prospected by L. Goyett and others. At the time of visit the underground workings were flooded and only the surface exposures could be examined. A 4-foot vein of quartz striking N. 10° E. and dipping west has been opened by an inclined shaft which follows the vein for 50 feet. From the bottom of the incline a vertical shaft was sunk 25 feet deeper and a 20-foot crosscut run to the vein, which at this place is reported to be 8 feet thick. Ore from this part of the vein is composed of glassy quartz with considerable pyrite and arsenopyrite. No accurate figures were obtained to show the quantity of gold contained, but specimens of this ore crushed and panned by the writer yielded a good showing of colors. The gold is said to be concentrated in rusty fractures which penetrate the quartz.

On the same claim an 8-inch vertical vein striking N. 70° W. has been opened by a shallow pit near the shaft house and has been traced westward for some distance. The vein is glassy quartz with considerable arsenical pyrite.

The workings on the Thompson claim are half a mile west of the Rose shaft, at an elevation of 1,775 feet. A 24-inch vein of quartz was first opened for 15 feet by a vertical shaft, and 40 feet below the mouth of the shaft a tunnel was started to cut the lode at this depth but was driven nearly parallel to it for 100 feet. A crosscut turned off for 20 feet in the direction of the vein opened a 5-inch quartz stringer but failed to locate the large vein exposed on the surface. The country rock is black mica schist and black graphitic schist. Both the quartz stringer and the adjacent wall rock are said to contain gold.

The Hidden Treasure claim, located in 1909 by L. Goyett, is near the main forks of Last Chance Creek, at an elevation of 1,350 feet. The east end of the claim joins the Newsboy property. A tunnel was driven 250 feet on this claim to open a mineralized fault zone. Horizontal movement in an east-west plane is indicated by the direction of grooves produced along vertical polished walls. Gash veins have been deposited along fractures as nonpersistent lenses of quartz,

forming a stringer lode which does not extend to the face of the workings but seems to pitch beneath the level of the tunnel. The vertical range of mineralization has not been determined. Gold may be panned from the quartz stringers and included schist, but the exact value of the rock is not known. A mill run was made on a shipment of ore taken near the mouth of the tunnel, but no returns were obtained, as the amalgam was lost.

top of ridge.

DOME CREEK
VALLEY.

Near the head of Dome Creek (see fig. 8) is a group of claims which has attracted unusual attention, owing to the reports of high-grade ore produced. The property has been developed under lease by several companies and is now held by the Reliance Mining Co., but Capt. W. L. Spaulding, one of the locators, has, with various associates, been the principal operator, and the property locally bears his name. On the expiration of the Spaulding-Ronan-Cunningham lease the property

was taken over by Spaulding & Brumbaugh, who, under the name of the Soo Mining Co., are developing the Soo and adjoining claims under lease from the Reliance Mining Co. A portion of the Wild Rose claim is leased to McGillvray & Ellis.

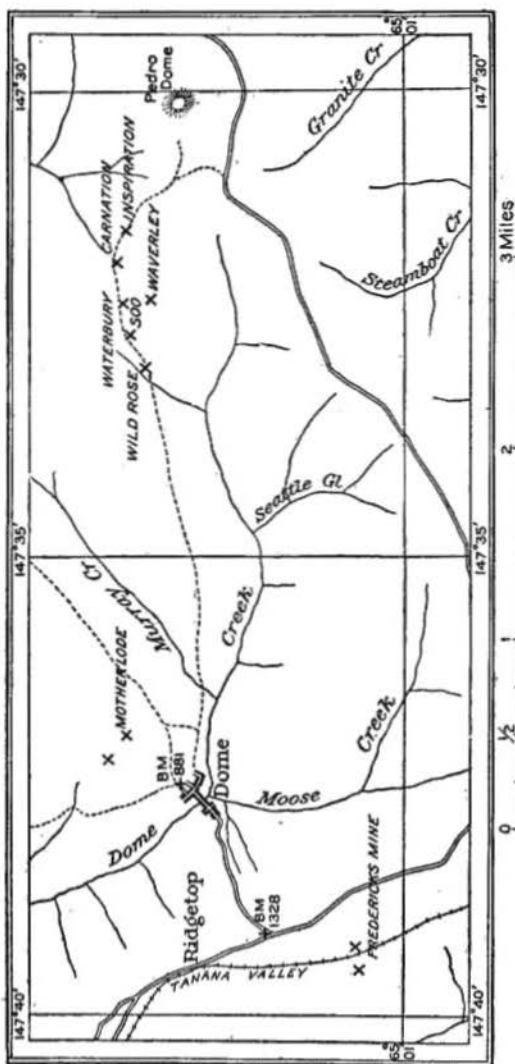


FIGURE 8.—Sketch map showing location of lode prospects in Dome Creek valley near top of ridge.

Location was made on two east-west veins which are nearly parallel but converge toward the east and also with depth. The northern vein is named the Soo vein and the other one the Wild Rose. Intersecting these two at about 45° is the chief vein, which dips 50° NW.

The Wild Rose vein has been developed by an inclined shaft which follows the vein for 100 feet on the end line between the Wild Rose and Soo claims. On the Soo claim, the principal producer of the group, drifts 440 and 300 feet long have been turned off to the east on the 50-foot and 100-foot levels, respectively, and the vein has been mined out and milled between the surface and the 50-foot level for 350 feet east of the shaft and between the 50 and 100 foot levels for 200 feet. Most of this work has been done since December, 1912. The vein has been traced westward by a short drift on the 100-foot level on the Wild Rose claim, and it is also being developed by an inclined shaft on the same claim. At the time of visit in 1913 this shaft was down 60 feet and drifts had been run from the bottom for 15 feet on the vein in both directions.

Faulting has displaced the vein in a number of places. Near the surface, in a stope now mined out and filled with waste, the vein was displaced for some distance along a fault fissure vein, and in the lower level a number of nearly parallel faults have broken the vein into irregular blocks connected by seams of gouge caused by drag along fault planes, and the same stresses have sheared the small fault blocks, causing movement along a system of minute parallel planes. This movement, in places at least, was later than the sulphide mineralization and has involved particles of both stibnite and gold.

Sulphides are not abundant, but small bunches of stibnite with a little galena occur in the vein, and tetrahedrite and sulphides of copper are reported.¹ The richest portions are localized in ore shoots which appear to dip eastward. These rich portions of the vein have a shattered appearance and evidently have been enriched by gold-bearing solutions introduced later than the formation of the vein. Within the ore shoots are small pockets of very rich ore, with many fine aggregates of visible gold. Locally the vein widens and narrows both horizontally and vertically, and here and there it pinches to a mere seam of gouge.

The Soo vein has been prospected by a 100-foot shaft on the line between the Soo and Waterbury claims and by other openings, none of which were accessible at the time of visit in 1913.

The Soo Mining Co. maintains two mills. Near the shaft of the mine a small mill of local manufacture is used for making test runs. It is equipped with three stamps of 250 pounds each and has a capacity of about 3 tons of ore a day, but its capacity is limited by

¹ Smith, P. S., op. cit., p. 179.

the available water supply, which is obtained by pumping from the shaft and is sufficient for only three or four hours a day. The mill, however, serves its purpose for making test runs, which are much more satisfactory than assays. A Joshua Hendy mill equipped with two 1,000-pound stamps is situated on Dome Creek half a mile from the mine and 600 feet lower in elevation. The ore is crushed at the mine and delivered by wagons to the ore bins at the mill, where it is shoveled into the hopper and crushed to pass a 40-mesh screen. The pulp flows over the plates into a Pierce amalgamator, which catches all quicksilver and rusty gold that pass the plates. Water for the mill is taken from the creek. Bunches of pure sulphides when noticed in the ore are not milled but are thrown aside to prevent sliming the plates.

The mill was installed in November, 1912, and since that time has been able to treat all the ore produced by the property. The capacity is about 10 tons of ore in 24 hours. The location was chosen as the most convenient for the water supply and also with a view to future operations. The plan of the operators is to start a crosscut tunnel near the mill, at the proper elevation to deliver rock to the ore bins, and drive it northward to cut the ore bodies at about the 600-foot level. This would prospect half a mile of ground, provide an adit for the removal of ore, and save hoisting and a subsequent downhill haul. It would seem advisable, however, to prove the vein to a greater depth before driving a long tunnel to the lower levels.

VAULT CREEK VALLEY.

The Fredericks mine, on the east slope of Vault Creek valley, was not in operation at the time of visit in 1913, although some development work has been done and a small production is reported.

A vein on the Bunker Hill claim, on Wildcat Creek, was prospected last spring and a test run made on a shipment of 8 tons of ore. The ledge is said to be 24 inches wide at the surface.

GOLDSTREAM CREEK VALLEY.

ROSE CREEK.

On Rose Creek, the main tributary of Gilmore Creek, considerable prospecting has revealed a number of quartz veins, but at the time of visit in 1913 only one man was working. Near the head of the eastern branch of the creek William Brown is developing several claims, situated near the contact of the porphyritic granite with schist. On the west side of the creek, about 2,000 feet above the mouth of Evening Star Creek, on the Green Mountain claim, a small open cut has been made on a large quartz vein at least 15 feet across. About

60 feet to the east a tunnel started to crosscut this vein has intersected a brecciated mass of schist with numerous local slips, containing small quartz veins and gouge seams between blocks. Not enough work has been done to determine the extent of the quartz. No assays have been made, but free gold can be panned from the crushed rock.

The Woodpecker claim lies in the granite area southeast of the claim just described. Here seven holes from 5 to 20 feet deep have disclosed the presence of a number of narrow seams of quartz and quartz-feldspar rock. The weathered surface of the granite is reported to contain small quantities of gold.

Near the dome on the ridge between the heads of the main forks of Rose Creek, at an elevation of 1,825 feet, a prospect hole has opened a lode 6 to 8 inches wide, striking N. 30° E. and dipping 70° NW., composed of quartz and feldspar. A 15-foot shaft and incline has been put down following the vein. A line of prospect pits at right angles to the strike of this vein has opened several other parallel veins. The only result of mineralization apparent is a small amount of stibnite in tiny veinlets. A number of other locations have been made on Rose Creek, some on lenses of bright glassy quartz showing no trace of metallization.

A dark-green schistose rock composed essentially of serpentine and magnetite is said to contain platinum, but no trace of this metal was found in samples submitted for analysis to E. E. Burlingame & Co., of Denver.

STEAMBOAT CREEK.

On Steamboat Creek several claims have been located and a little development work done. (See fig. 9.) These locations are on the fork entering from the north, about a quarter of a mile from its mouth. On the east side of the creek is the Silver Dollar claim, on which a tunnel has been driven into schist for a distance of 25 feet. The only result of mineralization apparent is a network of tiny veinlets of quartz along joint and fracture planes in the schist. A few cavities are filled with limonitic material, but no visible gold or sulphides are apparent.

Across the creek on the May Florence claim is an abandoned tunnel, now inaccessible, and on the hillside above it a shaft has been sunk 23 feet with the evident intent of connecting with the tunnel. The shaft is opened along a brecciated mass of schist with much blue gouge but no quartz lying between two parallel faults. A cabin stands on the property, but no one was working there at the time of visit.

GRANITE CREEK.

On the Birch & Anderson property, on Granite Creek about three-quarters of a mile above the mouth, the developments consist of a shallow shaft and a tunnel 390 feet long which intersects three parallel lodes. These have a general easterly direction.

The most southerly lode is a brecciated zone in the schist, healed with numerous quartz stringers strongly impregnated with pyrite and arsenopyrite.

The middle lode, known as the "blue-clay lead," is cut by the tunnel 186 feet from the portal. It is a 50-foot ledge composed prin-

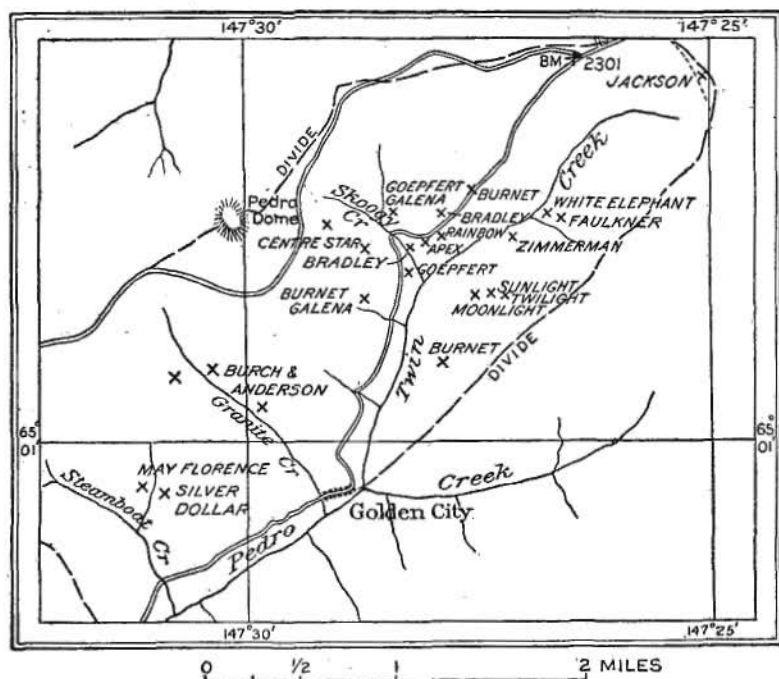


FIGURE 9.—Sketch map showing location of lode prospects in Twin, Skoogy, Steamboat, and Granite Creek valleys.

cipally of quartz inclosing horses of country rock and veined by numerous seams of blue-clay gouge. Both quartz and schist are strongly impregnated with pyrite and arsenopyrite.

Extending for 30 feet to the face of the tunnel is the third lode, composed of quartz carrying arsenopyrite and pyrite and specks of free gold. The discovery was made on this ledge, and a shaft was sunk on it for 14 feet. The tunnel that was run to intersect it at depth disclosed the other two ledges.

At the time of visit assays were being made to determine the value of the prospects, but the result was not learned. The third lode is

the only one that is interesting the owners at present, as the ores of the other two are known to be base, and in this locality little interest is now being taken in other than free-milling ores. The size of this ledge and the ease with which a large amount of ore could be extracted favor further exploitation of this property.

TWIN CREEK VALLEY.

UPPER TWIN CREEK.

A number of locations have been made at the head of Twin Creek, and a little development work has been done by Nerich, Jackson & Faulkner. On the White Elephant claim a 20-foot tunnel was driven but has caved in, obscuring the relations. Flat lenses of galena lying parallel with the foliation of the schist are associated with stringers of quartz. One such body of galena measuring 9 by 5 feet and 5 inches thick was taken out and milled. It is reported to have carried considerable silver. A little pyrite occurs with the galena. Alteration of the galena has resulted in cerusite and an impure mixture of lead oxide and limonite.

RAINBOW MINE.

The Rainbow mine, situated east of Skoogy Gulch, is developed on an 18-inch nearly vertical east-west quartz vein which occupies a fault plane traversing schist, quartzite, and granite. Besides a short drift on the 50-foot level two main drifts 135 feet and 190 feet long have been driven to the east and to the west respectively from the 100-foot level and two chambers stoped out.

Underground workings and surface prospecting have roughly outlined the upper surface of a pitching ore shoot. Prospect pits and surface trenching show the ore to extend from the west end of the claim to a point 12 feet east of the shaft; beyond this point the vein is of low tenor. On the 100-foot level the ore extends to a point 135 feet east of the shaft. Between these two points the boundary between ore and vein material of very low grade extends in an irregular but definite line that is 35 and 100 feet distant from the shaft on the 50 and 65 foot levels respectively. To the west ore has been proved for 240 feet on the surface and 190 feet on the 100-foot level, and it is assumed that the included portion of the vein is also ore. This ore body thus appears to be an eastward-pitching ore shoot with a stope length of at least 325 feet.

At the time of visit no work had been done on this property since May, 1913. Previous to that time 480 tons of ore had been shipped. A 10-stamp Straub mill with an electric amalgamator was erected last spring and an experimental run made on 45 tons of ore, but as this was not considered successful the mine was closed. It is the hope of the operators to install a 5-stamp Hendy mill and resume work in the near future.

HARRAIS CLAIMS.

Across the creek from the Rainbow mine a promising lode has been located on the Moonlight, Sunlight, and Twilight claims. This property was taken over last spring by Martin Harrais and is being actively developed. The vein has been traced by prospect pits for 2,500 feet and in this distance shows no displacement through faulting, although it is broken into small irregular blocks between which some movement has taken place. The vein strikes N. 70° W. and dips steeply northeast. It cuts both quartzite schist and granite, but the proved productive part lies wholly within the schist.

An ore shoot with a stope width of at least 650 feet extends across parts of two claims. In this ore body the discovery shaft has been sunk to a depth of 50 feet, and 20 feet of drifts have been turned off. No accurate sampling has been done, but rock taken at random from different parts of the ore body is said to contain gold in paying quantities. Over 100 feet of tunnel has been driven to cut this ore body at depth.

The average width of the vein is less than a foot, but locally it swells and pinches, ranging from a few inches to over 4 feet. The vein is composed of quartz with a considerable amount of sulphides occurring in veinlets that are evidently of later origin than the deposition of the quartz. Gold occurs both in the quartz and in the sulphides. Subsequent to metallization the vein has been brecciated, providing narrow crevices in which particles of gold have collected.

BURNET LODES.

On the east side of Twin Creek, below the mouth of Skoogy Gulch, a Mr. Burnet has opened up some gold-bearing quartz. In working a narrow bench placer deposit it was discovered that the irregular granite bedrock and the adjoining bank contained gold, so as much of the weathered surface of the granite as could be removed easily was shoveled into the sluice boxes with the gravel. This work disclosed the presence of a number of parallel quartz veins. The gold in the granite is thought to be due to concentration from the brecciated surface portion of the veins.

The Burnet quartz lode, on the west side of Twin Creek, has been opened by a short open cut that exposes only the weathered part of the vein. The lode is a flat-lying body of quartz in the center of which are lenses of galena. The quartz has many cubic cavities containing limonitic material, probably derived from pyrite. Next to the lenses of galena the quartz is banded with alternating layers of limonite. The galena-bearing lode is later than at least part of the fissuring which followed the intrusion of the granite, as it cuts a vertical vein of quartz which cuts the granite. An assay of the galena is said to show a rich silver content. Secondary minerals which have formed from

the alteration of the galena are pyromorphite and cerusite. These occur as incrustations and are evidently of no value as ore minerals.

SKOOGY GULCH.

On Skoogy Gulch considerable prospecting has been done, but none of the properties have yet reached a producing stage.

ESTER CREEK VALLEY.

HUDSON MINE.

Little work is being done in the vicinity of Ester Creek except on the Hudson mine (see fig. 10), located on the ridge between Ready



FIGURE 10.—Sketch map showing location of lode prospects in Ester Creek valley and vicinity.

Bullion Creek and Moose Gulch, at an elevation of about 1,500 feet. A vertical shaft had, at the time of visit in 1913, been sunk 180 feet and a number of levels turned off. The principal work has been done on the 100-foot level, a plan of which is shown in figure 11. From the station 20 feet west of the shaft the "big lead" has been opened

for 160 feet north, to a point where it is abruptly cut off by a fault perpendicular to the direction of the tunnel and dipping 60° SW. A polished and striated fault plane covered with gouge marks the hanging wall of the ledge, which appears to be a crushed zone, 15 feet wide, filled with stringers and lenses of quartz and masses of mineralized schist enveloped in gouge. The footwall is less clearly defined but is marked by a seam of gouge along which vein matter and wall

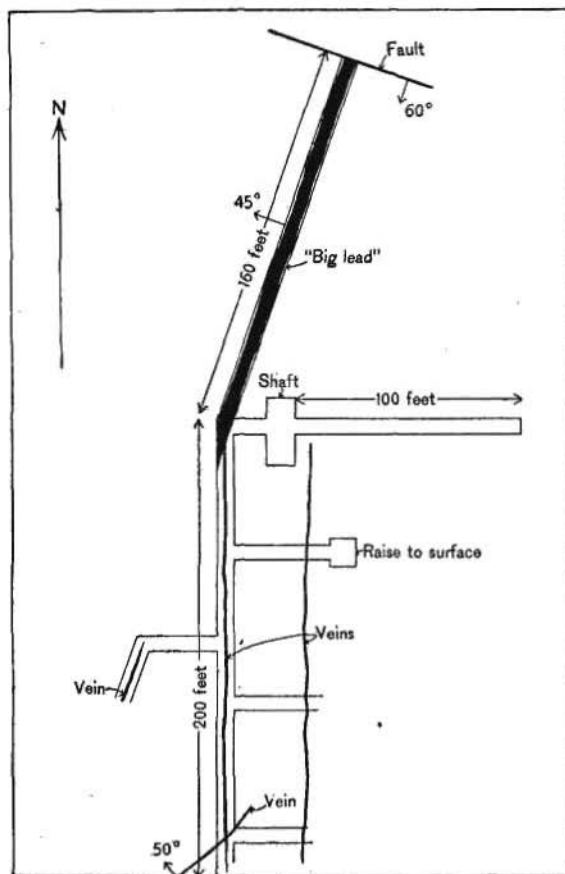


FIGURE 11.—Plan of 100-foot level of Hudson mine, showing various lodes.

rock easily separate. Along the fault that cuts off the ledge at the north end of the drift a crushed zone 2 feet thick, similar to the ledge, has been healed with quartz stringers.

Another lode opened on this level is called the "spur vein" by the miners, as it appears to join the larger vein. It may be an older vein cut by faulting previous to the formation of the larger vein. It has been opened by a drift from the station west of the shaft for a distance of 200 feet to the south. It averages 4 inches in width and is

composed of dull, opaque quartz with many open cavities into which well-formed quartz crystals project. Many of these crystals and some fractures are covered with a black coating of manganese oxide. Stibnite, the only sulphide detected, occurs sparingly. Where the vein traverses soft schist it is nearly solid quartz, but in quartzite it splits up into very narrow veinlets which are hardly distinguishable from the country rock. The amount of gold in the vein at such places is said to be small. At one locality a quartz lens included in the schist has been cut by this vein and has been mineralized with gold and stibnite by the tiny branches of the anastomosing quartz vein.

About 100 feet from the station a crosscut from this drift toward the west for 30 feet opened a ledge that is probably the continuation of the "big lead," whose strike would bring it near this point. Near the end of the drift a stringer was cut which strikes N. 45° E. and dips 50° NW. It is composed of brecciated iron-stained quartz.

Crosscuts driven east of this drift and one driven east of the shaft have tapped in a number of places veins of quartz, which from their position and similarity are thought to be parts of the same ledge. This ledge is composed of a number of stringers of quartz and included schist. All is more or less mineralized, as well as the inclosing wall rock for several inches from the vein. Individual stringers show a variety of dip, but the lode maintains a general north-south trend.

The best ore is said to occur in stringers in the "big lead" from the surface to the 70-foot level and is found in very rich shoots. At the time of visit no ore was being milled, as work was confined to proving the extent and values of the known veins and the possible occurrence of other ore bodies before attempting to mine out ore already blocked out.

READY BULLION CREEK BASIN.

The Farmer lode, situated on the divide between Nugget and Ready Bullion creeks west of Ester Dome, has been opened by Hudson Bros. on a lease. An inclined shaft was sunk 60 feet on a north-south vein, which dips about 45° E., but work was abandoned as the results did not encourage further development.

On the Flagler prospects, north of Ester Dome, only assessment work has been done.

The Cotton Blossom and Barker & McQueen claims have been prospected by William Harp. On the Cotton Blossom claim a tunnel and crosscuts aggregating 100 feet were driven in a mineralized area. A number of small stringers were cut, but no definite lode was found. On the Barker & McQueen claim two shafts, 40 and 45 feet deep, were sunk and an incline was driven along a

narrow stringer for 100 feet. A short drift turned off from the incline cut a ledge said to be 4 feet wide, from which 4 tons of ore was milled and yielded fair returns. Work will be continued on this prospect.

The Blue Bonanza claim, at the head of the western fork of Sheep Creek, has been prospected by a shaft 130 feet deep. A surface zone from 12 to 15 feet deep yielded small pockets of very rich ore, but the rock below this zone is said to be low in gold content.

About a quarter of a mile from the mouth of the creek Tyndall & Finn have located several claims and done a little development work.

EVA CREEK BASIN AND VICINITY.

Considerable prospecting has been done on the ridge between Eva Creek and the headwaters of Ace and St. Patrick creeks. (See fig. 12.) Some promising lodes have been uncovered, but little work was in progress at the time of visit in 1913.

George Comstock has opened several claims on the east slope of Eva Creek about three-quarters of a mile from Ester Creek. On the Crown Point claim an inclined shaft has been driven for 20 feet along two narrow quartz veins, one 2 inches and the other half an inch thick, filling parallel joints in schist. These veins, which strike N. 40° W. and dip 65° SW., are separated by 4 feet of soft chloritic schist with joint planes parallel to the veins. Along the hanging wall of the larger vein is a narrow seam of gouge. The adjacent schist for about 7 inches is altered to yellow sticky clay. The quartz veins contain specks of visible gold and the wall rock is said to contain a little gold.

In the saddle northwest of the Ryan lode at an elevation of 1,300 feet the Fairchance claim is being developed by McGlone & Smith. From the bottom of a vertical 40-foot shaft 120 feet of levels have been opened, besides a short drift on the 18-foot level and a stope near the surface. The surface exposures showed no definite lead but a mass of crushed schist and quartzite, with considerable quartz, also badly crushed and mixed with blue gouge, all containing small amounts of free gold. The underground workings show the continuation of this mineralized zone dipping steeply in a general southeasterly direction. Stringers of quartz and seams of blue gouge penetrate schist and quartzite, which are somewhat crushed but less so than the surface rock.

On the 40-foot level the southeast crosscut has opened this mineralized zone from a point 15 feet from the shaft for a distance of 45 feet to the face of the opening, where it is cut off by a fault striking N. 30° E. and dipping about 70° SE. In a parallel crosscut on the 18-foot level this stringer lead has been opened for 30 feet. Near the

surface on the northwest side of the shaft a stope has been opened, disclosing an irregular-shaped body of quartz, much of it crushed to a fine powder and so crumbly that it can be shoveled like gravel. This appears to be the surface portion of a northwestward-dipping

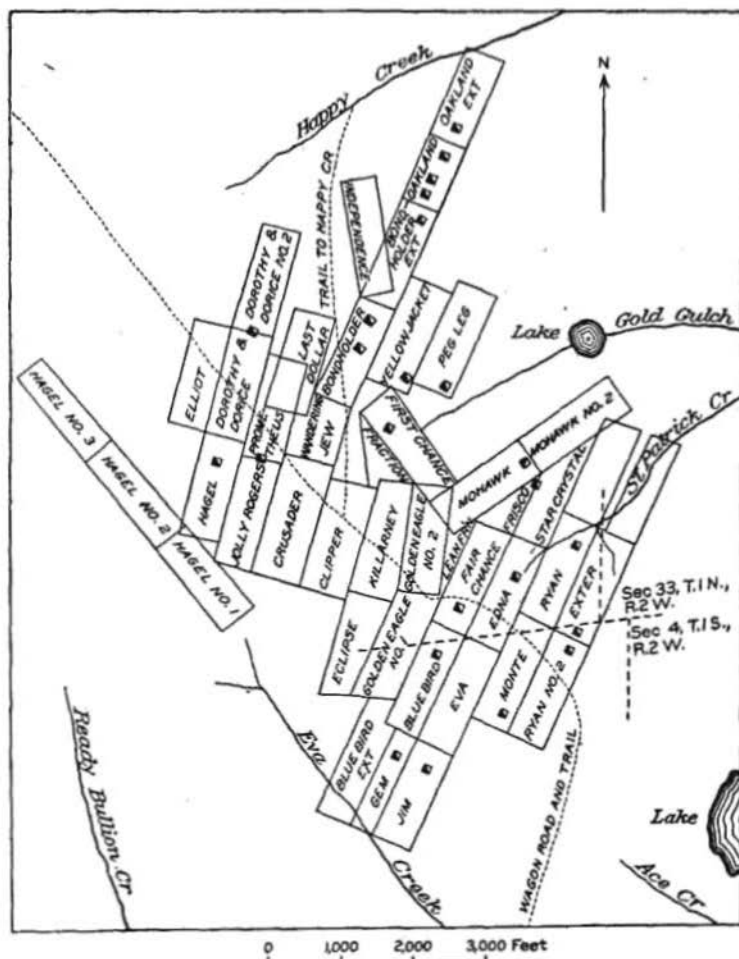


FIGURE 12.—Sketch map showing claim locations at head of Eva Creek.

vein, which should be found in place at depth by crosscuts driven northwest.

Several other claims are being worked by McGlone & Smith. Near the head of Happy Creek the Dorothy and Dorice and Dorothy and Dorice Extension claims have been located on what appears to be the same lode, striking N. 40° E. The openings are now caved. On the Frisco claim a vein striking N. 45° E. has been prospected by a 20-foot shaft from which 70 feet of drifts are turned off. On the

surface the vein dips 30° NW., but it appears to steepen in depth. The ledge, which is about 11 feet thick, is composed of several parallel veins of quartz with much included schist. Along a well-defined hanging wall movement has taken place in the direction of the dip of the vein, as shown by striations on the gouge. Small quantities of gold are contained in both the quartz and the included schist.

A short distance below the Dorothy and Dorice claim a shaft has been sunk on the junction end line between the Prometheus and Jolly Rogers claims by Hess & Thomas. The workings were not accessible, but samples taken from the dump show the ore to be white opaque quartz, badly crushed and containing angular fragments of clearer quartz. The microscope shows a fine aggregate of crystalline quartz containing fragments of an older quartzose rock. A still later phase in vein formation has been the sulphide metallization in the form of fine veinlets of stibnite. A coating of antimony oxide has given the rocks in places a greenish-yellow stain.

Near the head of Gold Gulch, the north fork of St. Patrick Creek, Tyndall, Finn & McLoughlin have located a number of claims and have done some development work. On the Bondholder claim a lode which strikes N. 20° E. and dips 40° NW. has been traced for 500 feet on the surface and opened by an incline for 20 feet along the vein. The ledge is about 6 feet wide and is composed essentially of quartz with inclusions of fragments and lenses of schist. A seam of gouge marks the hanging wall, along which the richest ore occurs in a quartz stringer having a greenish color. Particles of free gold occur in the quartz but were not detected except along the hanging wall. Sulphides were not noted in the vein. The footwall is not well defined but is made up of a number of parallel joint planes, each with a narrow seam of gouge. The vein has been traced across three adjoining claims, the Bondholder Extension, Oakland, and Oakland Extension.

PLACER MINING IN THE YUKON-TANANA REGION.

By THEODORE CHAPIN.

During an examination of the Fairbanks lode region in 1913 a few notes were gathered relative to the progress of placer mining in the Fairbanks district and other parts of the Yukon Valley. Many of the data were obtained from operators and others, and special thanks are due to Messrs. N. G. Myers, of Eagle; Frank Morrison, of Circle; George L. Morrison, of Hot Springs; and R. C. Wood, of Fairbanks.

FAIRBANKS DISTRICT.

GENERAL CONDITIONS.

The value of the placer gold produced in the Fairbanks district in 1913 was \$3,300,000. The production in 1912 was valued at \$4,150,000. This falling off was due to a general drought, which affected the entire Yukon Valley. No rain fell until the later part of July, and all placer-mining operations were hampered by lack of water. This drought and the early freeze up in the fall combined to make the working season unusually short.

About 130 plants were working a whole or part of the summer season, employing probably 1,500 to 1,800 men. Much less work was done in the winter. The customary wages of \$5 a day and board (reckoned at \$2 a day) were paid. Although 200 men left Fairbanks for the new diggings at Chisana Creek, no shortage was felt. New discoveries were made on Alder, Smallwood, and Happy creeks. The productive areas of Chatanika Flats, at the mouths of Dome and Cleary creeks, continue to increase, and on Fairbanks and Dome creeks new productive ground was discovered.

The tendency is toward the open-cut method of mining, and some claims are now being profitably mined in this manner which have heretofore been considered too deep. Two innovations in mining appliances are the wheel scraper that was used on Pedro Creek and the underground scraper that was being tested in some of the deep workings on Chatanika Flats.

A power company has been organized to develop power in the Nenana coal fields by coal in winter and water in summer, to work the placers of Tatlanika and Totatlanika creeks, which are practically above water.

CHATANIKA RIVER BASIN.

Cleary Creek was the principal producer of the district, owing to the extension of the productive ground at the mouth of the creek in Chatanika Flats. Fifteen outfits employing about 250 men were at work on the creek during the summer. On Freeman Bench, opposite Discovery, prospecting has located a new pay streak.

A little mining is being done on the tributaries of Cleary Creek. Five outfits on Wolf Creek and three on Chatham Creek were attempting to work with what water was available.

The effect of the drought was felt less on Dome Creek than on other creeks in the district. Thirteen outfits worked for most of the season, employing about 100 men during the summer. On the Chatanika Flats, near Olness, a number of large plants were successfully operated during the summer.

On Vault Creek considerable ground had been blocked out in preparation for the summer's work, but water was not available for the entire season. One hundred men were at work during a part of the season. The Alabama Association was the principal producer. Several other large groups were in operation.

On Treasure and Wild Cat creeks two outfits were working about 20 men.

On Little Eldorado Creek six plants were in operation in 1913, employing 75 men. The previous winter 20 men were employed blocking out ground. No work was done on Homestake Creek in 1913.

In the Chatanika Flats more mining is being done than ever before. Ten outfits employed 500 men during the summer. Two companies were experimenting with an underground scraper which digs and dumps automatically into a car 20 feet from the working face of the tunnel.

GOLDSTREAM CREEK BASIN.

Goldstream Creek continues to be one of the principal producers, although the production is falling off from year to year. The tendency is toward open-cut methods, and each year drift mines that have been failures are being successfully operated by open cutting. During the summer from 25 to 30 outfits employed 250 to 300 men. Winter work was carried on in the drift mines and a few men were employed on some of the open-cut mines in blocking out ground.

Seven men were working on First Chance Creek, a tributary that enters Goldstream Creek from the southeast near "No. 5 below." In August two men were working in Hansen Association claim. A shaft had been sunk 42 feet to bedrock and 56 feet of drifts turned off. The pay streak is said to be 4 feet wide and to contain \$2 a square foot. Three other claims were being prospected. There was no production in 1913, but winter dumps were taken out.

On Pedro Creek 10 outfits were working during the summer of 1913, employing about 125 men. Little winter work was done, as the gravels are shallow and most of the mines employ open-cut methods. On claim "No. 8 below" a wheel scraper was being used for the first time. It has a capacity of 16 cubic feet and is said by the operator to be more efficient than the Bagley bottomless scraper, so universally used in this district, because it requires only one-third the amount of fuel to move the same amount of gravel. It is operated by two men and dumps automatically.

On Gilmore Creek six outfits were at work during the summer, employing 20 to 25 men. On New Years Pup, a branch of Rose Creek, one man was sluicing. Water was hardly sufficient for use, but by damming the creek enough could be collected to sluice for several hours at a time. The gold at this place is coarse.

No mining was in progress on Twin Creek in 1913, but it is reported that the Fairbanks Gold Mining Co. has secured an option on several claims with the view of installing a dredge.

On Engineer Creek three plants employed an average of 50 men during the summer of 1913.

FISH CREEK BASIN.

The production from Fairbanks Creek for 1913 probably exceeded that of the previous year. The productive area was increased by new discoveries in 1912 and also in 1913. The gravel deposits are deep, and both winter and summer work is carried on. The dredge of the Fairbanks Gold Mining Co. has been digging on Fairbanks Creek for three seasons. Early in the summer of 1913 the operators experienced considerable difficulty with low water, but later reports indicate that they had a fairly successful season. New discoveries have been made on Deep and Alder creeks, tributaries of Fairbanks Creek.

On Pearl Creek two outfits were at work at the head of the creek, and near the mouth of Yellow Pup four men were working part of the summer.

On Last Chance Creek and tributaries several small plants were in operation.

CRIPPLE CREEK BASIN.

The Cripple Creek basin continues to be one of the principal producers of the Fairbanks districts. Winter work was continued on a large scale. Summer sluicing operations were somewhat curtailed by lack of water. One plant on Ester Creek was not able to begin sluicing until September 1. The productive ground on Eva Creek continues to increase. Gold-bearing gravel was discovered on this creek in 1911. In the summer of 1913 five plants were in operation employing 125 men. On Ready Bullion Creek two plants worked during the summer, one employing 50 and the other 8 men.

New productive ground was found on Happy Creek, a tributary of St. Patrick Creek. The plant on the Gold Hill claim, on Cripple Creek, was in operation winter and summer and employed 30 men.

CIRCLE PRECINCT.

GENERAL CONDITIONS.

The value of the gold produced in the Circle district in 1913 is estimated to be \$175,000. The production for 1912 was valued at \$325,000. The decrease may be in part accounted for by the drought which affected the entire Yukon Valley. On many of the creeks no water was available for sluicing until late in the season, and many claims were not worked at all. Forty outfits, including two hydraulic plants, operated for the whole or a part of the season, employing about 150 men. Probably 100 men took out winter dumps, some of which were not sluiced for lack of water.

BIRCH CREEK BASIN.

The Elmer dredge started to dig on Mastodon Creek about the middle of June. Early in the summer its operation was hindered by lack of water, but later reports indicate a successful season. Difficulties encountered in 1912 with frozen ground were avoided this season by working entirely in thawed ground. The contract has been let for another dredge that will be installed on Mastodon Creek.

The Berry & Lamb hydraulic plant on Mastodon Creek was started early in the summer but was closed part of the season, as there was not sufficient water. A new hydraulic plant was installed by A. P. Clark.

On Deadwood Creek and tributaries from 40 to 50 miners were working winter and summer. Three men were mining on Portage Creek. Early in the season 1,300 feet of ground was stripped ready for sluicing. It was hoped to have sufficient water to work the entire season without any interruption. A new strike was reported from Preacher Creek.

It is reported that a hydraulic plant will be moved from Mastodon Creek and installed on Independence Creek. One outfit of 12 men was mining on Half Dollar Creek during winter and summer.

UPPER YUKON BASIN.

In August 10 men were mining on Fourth of July Creek and others were ready to work whenever the water supply was adequate. Later in the season more plants were in operation. New productive ground was found on Ruby Creek but was not extensively prospected.

Early in the season Woodchopper Creek gave promise of being a better producer than ever before. About 20 men were mining on the creek and its tributaries. Mining is carried on both in winter and summer. One outfit took out a winter dump on Boulder Creek and was preparing to sluice. Six or eight men were mining on Coal Creek.

SEVENTYMILE, EAGLE, AND FORTYMILE RIVER DISTRICT.**GENERAL CONDITIONS.**

The value of the gold produced in the Seventymile, Eagle, and Fortymile River districts in 1913 is estimated to be \$150,000. In 1912 the production was valued at \$220,000. The drought was felt in this region as keenly as at any other place in Alaska.

One dredge was digging on South Fork of Fortymile River, near the mouth of Franklin Creek, and others are planned. It is the belief that large areas of low-grade ground in this region which can not be successfully worked in a small way can be profitably hydraulicked or dredged.

SEVENTYMILE AND EAGLE DISTRICTS.

By the middle of August about 35 men were at work in the Seventymile district, and later in the season, when water was more plentiful, the number was increased. In the Eagle district one hydraulic plant and several small outfits worked the entire season, employing about 20 men.

FORTYMILE DISTRICT.

In the Fortymile region about 25 miners took out winter dumps. The summer work was delayed by the lateness of the rainy season. In August about 50 men were at work and many others were ready to sluice whenever water was available.

The Atwater dredge on South Fork of Fortymile River, near the mouth of Franklin Creek, is reported to have had a successful season. Options were taken on a number of claims on Walker Fork and Davis and Poker creeks with a view of installing a dredge. Eighteen men were working on Squaw Creek with a bottomless scraper. Wade Creek is being gradually worked out. Considerable winter work was carried on, so the drought was less felt there than at some other places. No water was available in the early part of the season on Chicken or Denison creeks. Several outfits were mining on Ingle Creek. Negotiations are being made by a syndicate to control a large number of bench claims on Fortymile River and develop enough water to work them successfully.

SALCHAKET-TENDERFOOT REGION.

In the Salchaket region little work was in progress in 1913. On Tenderfoot Creek, Democrat Pup, and Banner Creek five plants were in operation, employing altogether about 50 men.

CHENA RIVER BASIN.

A small amount of mining was done on South and Middle forks of Chena River. On Smallwood Creek one outfit of five men was mining during the summer. A number of claims on Chena Slough, extending

from a point half a mile below Fairbanks to Hyde's ranch, have been examined, and it is reported that a dredge is to be installed on them in 1914.

HOT SPRINGS DISTRICT.

The production of the Hot Springs district for 1913 is estimated to be worth \$400,000. About 300 to 400 men were employed during the greater part of the season. The drought was less felt there than at many other places.

On American Creek several plants employed 30 to 75 men. Drifting methods are used and the gravel is raised to the surface by windlass. Several large plants were operating on Sullivan Creek, the principal producer of the district. Prospecting has extended the productive area on Sullivan Creek Flats near the mouth of Wood-chopper Creek, where more auriferous gravel has recently been found.

In the Baker Creek basin, Thanksgiving, Omega, Glen, Gold Run, Eureka, and Seattle Jr. creeks were worked in a small way, mostly by ground sluicing or by open-cut methods. Considerable prospecting was done on Cooney and Killarney creeks.

RAMPART DISTRICT.

In the Rampart district 20 outfits were in operation in 1913, employing about 60 men. About 20 men took out winter dumps. Two hydraulic plants operated on Hunter Creek and a successful season is reported. On Dawson Creek and Idaho Bar winter and summer mining was carried on. Four or five men mined on Quail Creek during the winter and 10 in the summer. Winter and summer mining was done on Little Minook and Little Minook Jr. creeks. A successful season is reported, considering the water shortage. A new pay streak was discovered on the bench between the two creeks. Ten men were making open cuts on Slate Creek.

PLACER MINING IN THE RUBY DISTRICT.

By HENRY M. EAKIN.

FIELD WORK.

The Ruby district was revisited by the writer late in the summer of 1913, after a season of exploration in the Yukon-Koyukuk region. Several days were spent in examining the active plants and gathering data regarding the progress of mining since 1912. The success of this brief visit was greatly enhanced by the operators and residents of the district in their painstaking efforts to furnish exact data and to extend courtesies and hospitality. Special acknowledgment is due Mr. Charles Forander, one of the original discoverers on Long Creek, from whose records the data regarding production are largely taken.

PREVIOUS INVESTIGATION.

The Ruby gold placer district was visited by A. G. Maddren in 1910 and by the writer in 1912. A summary of the geographic and geologic data gathered in these years has been published,¹ and a more complete report is in press.² The present paper is intended only to supplement the sections on economic geology contained in these reports, so that the published history of the camp will include the mining season of 1913.

GENERAL OPERATING CONDITIONS.

The population of the district has fluctuated considerably since the fall of 1912 and has changed greatly in personnel. The general trend is, however, toward a larger and more permanent population. Labor has generally exceeded the demand at the current wages of \$5 a day and board. In some instances lower wages have been paid.

Freight rates have been lowered somewhat from those of 1912 owing to increased competition among steamboat companies. General merchandise rates from Seattle to Ruby have been given as low as \$30 and \$35 a ton. Special classes of freight take rates 20 to 200 per cent above these figures.

¹ Eakin, H. M., Gold placers of the Ruby district and the Innoko-Iditarod region: U. S. Geol. Survey Bull. 542, pp. 279-303, 1913.

² Eakin, H. M., The Iditarod-Ruby region, Alaska: U. S. Geol. Survey Bull. 578.

Rough lumber has been reduced from \$50 to \$30 a thousand and dressed lumber from \$80 to \$60. Cordwood varies greatly in price, according to its availability. Many operators find it economical to hire wood cut and hauled by the day instead of at a fixed cord rate, the cost being lowered in some cases to \$3 a cord. Extensive use and forest fires have greatly reduced the supply of fuel timber, so that in future this element in the cost of mining will generally increase.

Transportation from Ruby to the creeks in the summer of 1912 took a rate of about \$10 a ton a mile. In 1913 this rate was reduced to \$5 or \$6 and even lower to some creeks. There was a corresponding reduction also in winter freight rates. This decline is due in part to increased competition in the business, in part to cheaper forage, and in part to improved roads.

An excellent Government road, used both in winter and summer, has been built from Ruby for 3 miles toward the creeks. From its end a winter road has been laid out over easy grades to the head of Long Creek. In summer the same trail is used as formerly, and it is for the most part extremely bad.

The water supply was exceedingly scant in 1913 owing to a prolonged drought. This seriously handicapped mining throughout the district, except the operation of plants equipped for pumping, and curtailed the season's total production from what could have been reasonably expected under ordinary conditions.

MINING.

GENERAL ACTIVITIES.

Mining was continued in 1913 on all the six creeks that produced in 1912, namely, Long, Upper Long, Midnight, and Trail creeks, Bear Pup, and Glen Gulch. The industry was also extended to eight other creeks of the district not previously productive—Lucky, Greenstone, Monument, Ophir, Poorman, Duncan, Tenderfoot, and Tamarrack creeks.

CREEKS PREVIOUSLY PRODUCTIVE.

Long Creek.—Long Creek continued in 1913, as in 1912, to hold first rank among the creeks of the district in the extent of known placer deposits, the importance of mining operations, and the amount of gold produced. The placer deposits of Long Creek below the mouth of Bear Pup apparently form a fairly continuous pay streak of variable size and richness. It reaches southward from the Cheyenne fraction, at the Long Creek settlement, for a distance of about 5 miles to the Long Creek Association ground, where the mine farthest downstream was located in 1913. The course of the pay streak is entirely independent of the present stream and of the topography of

the valley bottom. Consequently the depths of the mines vary, the bench mines being deeper than those on the present stream bottom. Considered in connection with surface elevations the depths of the mines show that the bedrock surface has a greater slope down the valley than the present flood plain. The Cheyenne fraction and Windy Bench mines, for instance, which are on a terrace 30 feet above the creek level at the north end of the pay streak, have depths of 40 to 50 feet. About 5 miles down the valley, on the Long Creek Association ground, is a productive mine whose shaft, starting at the flood-plain level of the creek, penetrates 85 feet to bedrock. Still greater depths are to be expected farther down the valley. In some of the deeper holes the gravels are thawed and ground water has given trouble. The deposits that may exist farther down the valley can be exploited only at much greater cost and risk than those upstream. The use of a drill in testing such ground is to be highly recommended.

The productive placer ground of Long Creek below the mouth of Bear Pup is held in nine association groups of claims and four fractional claims. Only one association group and two fractions were idle in the summer of 1913. Thirteen plants, employing about 125 men in all, were operated. The plants varied in capacity, but all were equipped with steam machinery that aggregated about 300 horsepower.

The winter work on Long Creek was confined chiefly to prospecting and blocking out ground. Five plants worked in a small way during the winter of 1912-13.

Upper Long Creek.—Claims Nos. 1, 2, 3, and 4 above Discovery, on Long Creek above the mouth of Bear Pup, were worked during the summer of 1913. During the previous winter the three claims above No. 1 were worked in a small way. The hand windlasses used in 1912 were replaced by steam machinery, the four plants aggregating over 100 horsepower. The later development work has shown the gold-bearing gravels to lie in irregular bodies rather than in pay streaks. This has required an unusual amount of prospecting, the results of which generally have not been all that could be desired. In places, however, very satisfactory ground has been opened. About 25 men were employed on upper Long Creek most of the summer and 6 men during the winter.

Bear Pup.—Claims Nos. 1 and 3 on Bear Pup were worked in the summer of 1913. The gravels are but 12 to 16 feet deep, and the mines are of the open-cut type. A single plant operated on each claim. Both were equipped with heavy steam machinery that was employed in scraping away the overburden, hoisting pay dirt to the sluice boxes, and pumping water for sluicing. The two plants aggregated 100 horsepower and employed 70 men continuously most

of the summer. Rapid progress was made on both claims and the results were very satisfactory.

No winter work is done on Bear Pup except prospecting and testing values in known placer ground.

Midnight Creek.—As in 1912, but a single claim was worked on Midnight Creek. A small steam plant, including a hoist, installed on the Jennie Association ground the preceding winter, was operated in the early part of the summer by six men. Later in the season the force was reduced to two men, who continued work the rest of the summer.

Although gold is widely distributed along Midnight Creek, the development work done so far has failed to reveal concentrations rich enough to yield much profit in mining. Very little prospecting has been done away from the original discovery, however, and it may be that the same effort spent in prospecting, especially in the lower part of the valley, would yield better returns in the long run than can result from the mining of such deposits as have already been found.

Glen Gulch.—Mining on Glen Gulch was confined to the operation of three small plants, which were at a standstill most of the summer owing to the water famine. Two of the plants did little besides prospecting and the third took out a small dump during the summer to be sluiced during the fall rainy season. Not more than six men worked on the creek at any time. No winter work was done.

Trail Creek.—Trail Creek was unique in the district in the relatively great extent of its winter mining. Four plants employing 16 men operated on separate claims most of the winter. Of these, two were very successful, in view of the scale of operations, and made considerable production. Early in the spring the mine farthest downstream, $2\frac{1}{2}$ miles below Discovery, shut down, and another mine was opened near the head of the creek, where some unusually good ground had been discovered during the winter. Four plants, employing about 30 men, were active throughout the summer. Owing to the scant water supply part of the winter dumps remained until late in the summer before they were sluiced.

The profitable mines of Trail Creek are all within 2 miles of the head of the stream. The pay streak is narrow and fairly continuous. It yields coarse gold for the most part. A nugget worth \$296, the largest yet produced in the district, was taken from the new mine near the head of the stream early in the summer.

NEW PRODUCTIVE CREEKS.

Location.—Discoveries were made on eight new creeks in the Ruby district during the winter of 1912-13 and the following spring. Four of these streams are in the same general area with the creeks already

producing. They are Lucky Creek, a westerly tributary of Flint Creek next north of Glen Gulch, and Greenstone, Monument, and Ophir creeks, which flow southward, the first to Long Creek, the others to Solatna River, in the area east of Long Creek below Midnight Creek. The other four new creeks drain an area that centers about 30 miles south of the Long Creek diggings. Three of these, Poorman Creek and its northerly tributaries, Duncan and Tenderfoot creeks, belong to the Innoko drainage system; the other, Tamarack Creek, heads against Duncan Creek and flows north to the Solatna.

Lucky Creek.—Lucky Creek is a small stream less than 3 miles in length and having no important tributaries. Its deposits are adapted for shallow drift mining, ranging from 16 to 30 feet in depth.

Two small plants, employing two and four men respectively, prospected separate claims on the creek during the winter of 1912-13. The work was continued during the following summer, but only a small production is reported to have been made.

Greenstone Creek.—Greenstone Creek is about 5 miles long. It heads in the same divide with Midnight Creek, near the same place, and flows southwestward to join Long Creek a little above its mouth. Shallow low-grade placer ground was located about 2 miles from the head of the stream in the winter of 1912-13. The known placers are all included in the Anaconda group—an association comprising four claims. The ground is 3 to 12 feet deep and is easily worked by open-cut methods. A single outfit employing five men worked throughout the summer. Lack of water for sluicing hindered the work greatly, but a profitable production was made. The cost of working this ground could be greatly lessened by the use of machinery, and in that case the outlook for the creek would be very encouraging.

Monument Creek.—Monument Creek is the next stream east of Greenstone Creek. It is about 8 miles long and flows southward to Solatna River. Good placer ground was discovered about midway in the stream's course, at and below the mouth of a small westerly tributary called Jack Rabbit Creek, during the winter of 1912-13.

Two plants, employing 17 and 5 men, respectively, were operated the whole summer of 1913. The ground is 35 to 40 feet in depth. It is well frozen, is adapted for economical drift mining, and is said to yield very satisfactory returns.

Some prospecting was done during the summer about 2 miles below the productive mines, and it is reported that pay dirt was struck at this locality late in August.

Ophir Creek.—Ophir Creek is the next stream east of Monument Creek and, like it, flows southward to Solatna River. Two outfits prospected on this creek in the early summer, one of which continued work throughout the season. A rich discovery was reported

and preparations for active mine development were under way the last of August.

Poorman Creek and tributaries.—Poorman Creek is the extreme northeastern headwater of the North Fork of Innoko River. It is a stream of considerable size, being 20 to 30 feet wide and having considerable depth and velocity at ordinary stages. It is reported to have gone completely dry during the drought of 1913.

The geology of the Poorman Creek region is similar to that of the district to the north. The formations include schists, slates, and greenstones, probably of earlier Paleozoic age. Immediately south of these rocks are cherts and less altered igneous rocks that may be considerably younger. The country is worn down to a very low relief. The interstream areas are occupied by broad, smooth ridges deeply mantled with products of rock decay and possibly in some places with recent lacustrine sediments. The lower slopes of the ridges merge with wide valley bottoms that are analogous to the alluvial plains of the lower Innoko. Both the ridges and the bottom lands are timbered. The trees, mostly spruce and tamarack, are for the most part of rather stunted appearance. Good-sized trees are fairly plentiful, however, along the banks of the streams and at their heads.

The first prospects discovered in this region were taken from the stream gravels of Poorman Creek in the spring of 1912 by Thomas Armstrong at a point about 8 miles southeast of Twin Butte Mountain. Several holes were sunk to bedrock the following winter, and on March 7, 1913, gold-bearing gravel was hoisted from a hole near the original discovery by Armstrong and his partner, Gus Olson. Since then a great deal of prospecting has been done in the region, and valuable placers have been located at three separate localities on Poorman Creek and on two of its tributaries, Duncan and Tenderfoot creeks. The lowermost locality on Poorman Creek is about $1\frac{1}{2}$ miles above the mouth of Tenderfoot Creek, and that farthest upstream, 5 miles above, is near the mouth of Duncan Creek. The locality on Duncan Creek is a mile above its mouth; on Tenderfoot Creek, half a mile above its mouth. The deposits are much alike wherever explored. Their depth ranges from 53 to 65 feet. The gold lies in a stratum of gravel on bedrock, 3 to 6 feet thick. The overburden is chiefly muck. The gold occurs for the most part in fine shot-like particles and shows the effects of transportation in wear and assortment. The widest crosscut in pay gravel on Poorman Creek is 125 feet, in the mine near the mouth of Duncan Creek. The development work done so far is not sufficiently extensive to demonstrate the existence of continuous pay streaks on Poorman Creek and its tributaries, but the evidence in hand all points in that direction. If this should prove to be the case, and if the width

and richness of the deposits known to occur locally should prove to be general, the production from this part of the district should quickly assume large proportions.

Mining was done at times during the summer on Poorman, Duncan, and Tenderfoot creeks, five claims in all, each worked by a separate plant. But little machinery had been taken into the region, so that operations were necessarily conducted on a small scale. The miners were further handicapped by an absolute lack of water for sluicing during a greater part of the summer. About 15 men in all were employed in mining.

Tamarack Creek.—Tamarack Creek is about 8 miles long. It heads against Duncan Creek and flows northward to Salatna River. Prospects were found on the creek during the spring of 1912, and pay gravel was located the following winter at a locality about 3 miles from its head. A small outfit employing four men worked on this ground during the summer of 1913.

SUMMARY.

The mining industry in the Ruby district has shown on the whole considerable advancement over the preceding year. The six streams that produced in 1912 were worked again in 1913, most of them with a largely increased scale of operations. The changes were brought about mainly by the installation of heavy steam machinery in place of the light hoists and hand windlasses used before.

Placers were discovered on eight new creeks, some of which are very promising. Prospecting is being done on still other creeks, and in places results are being obtained that suggest the likelihood of a further increase in the number of producing creeks.

All told, there were 41 plants engaged in actual mining in the Ruby district in the summer of 1913, operating 38 claims on 14 different creeks and employing a total of about 230 men. Of the 41 plants 33 were equipped with steam machinery that aggregated over 750 horsepower. The other 8 plants used hand labor.

During the winter of 1912-13 twelve plants were operated on as many claims situated on three creeks. About 40 men were engaged on this work.

The winter production of the district amounted to \$102,200. Data regarding the value of the summer's production are incomplete as yet, but it is estimated at \$750,000.