

LODE MINING IN THE FAIRBANKS DISTRICT.

By J. B. MERTIE, Jr.

INTRODUCTION.

Gold lode mining in the Fairbanks district continued in 1916, with a small production. The cost of power and supplies has increased so greatly that most of the operators have either closed their mines or are operating on a scale little more extensive than prospecting. Most of the operators having high-grade gold ore do not care to continue work under present conditions, which allow them only small profits, and the owners of lower-grade ore can not afford to operate at all. The general policy of all concerned in the gold mines is to await the coming of the Government railroad to Fairbanks, the expectation being that this will effect a general decrease in operating costs. Cheaper power is perhaps the most urgent need of the lode mines, and the Government railroad, by making available the coal resources of the Nenana and Matanuska coal fields, should help materially. A central power plant, utilizing perhaps the low-grade Nenana coal, may prove the ultimate solution of the difficulty.

Eight gold lode mines, however, were operated in the Fairbanks district in 1916, producing gold valued at nearly \$40,000. This is the smallest yearly production of lode gold and silver in the district since 1910, when the lodes were just beginning to be opened.

Lode gold and silver produced in the Fairbanks district, 1910-1916.

Year.	Total quantity of crude ore (tons).	Gold.		Silver.	
		Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1910.....	148	841.19	\$17,339	106	\$57
1911.....	875	3,103.02	64,145	582	308
1912.....	4,708	9,416.54	194,657	1,578	971
1913.....	12,237	16,904.98	349,457	4,124	2,491
1914.....	6,526	10,904.75	225,421	2,209	1,222
1915.....	5,845	10,534.91	217,776	1,796	910
1916.....	1,111	1,904.81	39,370	140	92
	31,450	53,610.20	1,108,221	10,535	6,051

The beginning of antimony mining in the Fairbanks district, the mining developments in 1915, and the occurrence, distribution, and

character of the ores have been described by Brooks.¹ The decline in the price of antimony early in the summer of 1916 led to the closing of most of the antimony mines in the district, only one being in operation at the time of the writer's visit in August. Notwithstanding this fact, the production of antimony was materially increased over that of 1915.

One silver-lead lode was operated in 1916.

Three tungsten mines were operated, producing about 16½ tons of scheelite concentrates. Prospecting for tungsten lodes was also actively carried on.

Plate XVIII shows the locations of the lode mines and prospects so far discovered in the Fairbanks district.

GOLD LODES.

The following report is intended only as an outline of progress made in lode mining in the Fairbanks district and not as a comprehensive description of all the lodes. Reference is made only to the producing mines and to some others that are being actively prospected. In a later report the writer will present generalizations based on a study of the lode systems and their mineralization and will include the results of petrographic and metallographic studies of the ores.

The eight gold lode mines that were worked in 1916 were that of Crites & Feldman, on Moose Creek; the Mizpah, on Fairbanks Creek; the Homestake, at the head of Wolf Creek; the Mohawk, at the head of Eldorado Creek; that of Nars, Anderson & Gibbs, between Moose and Too Much Gold creeks; the Ohio group (Gilmore & Stevens), on Fairbanks Creek; the Center Star, on Skoogy Gulch, tributary to Twin Creek; and the St. Paul, at the head of Eva Creek.

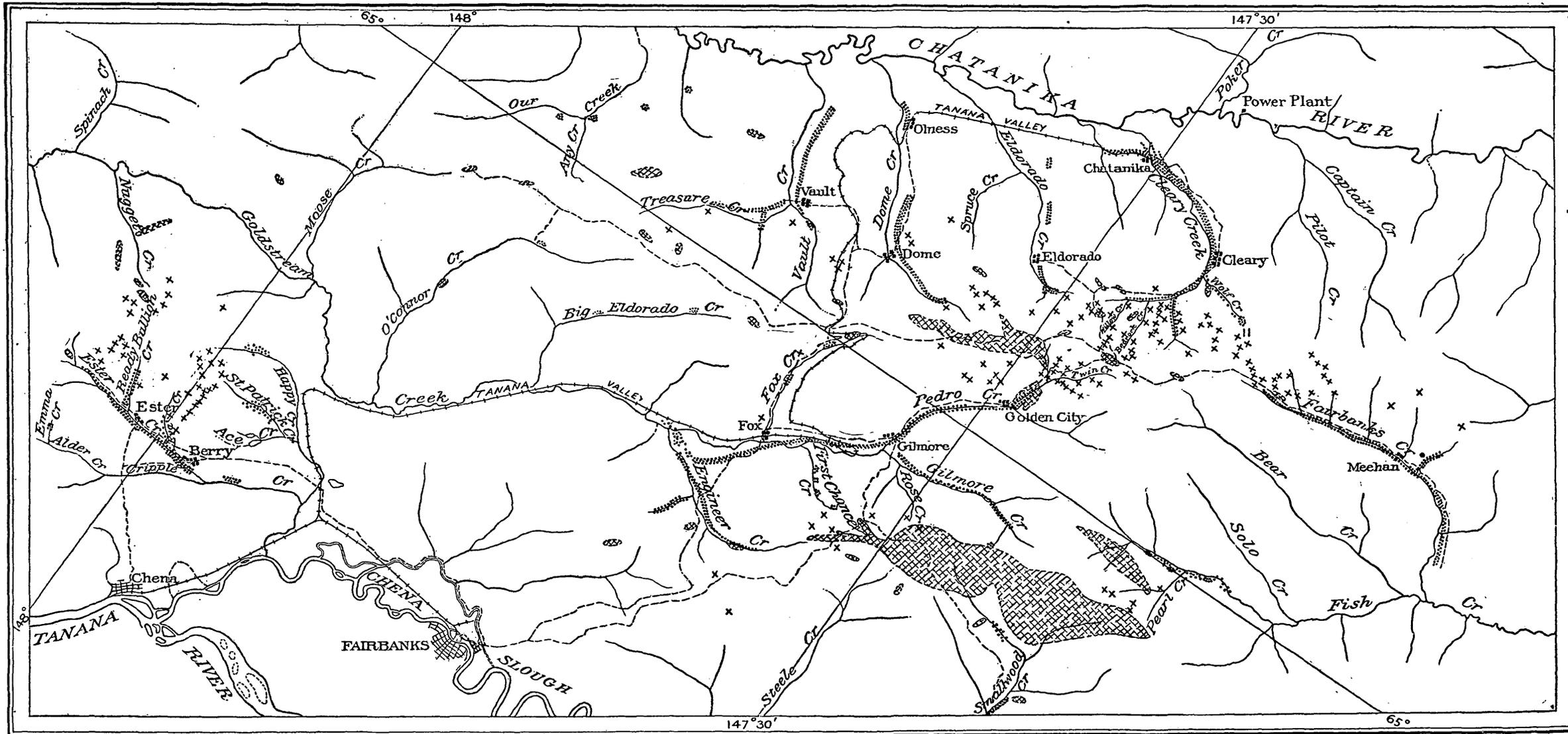
CRITES & FELDMAN.

The Crites & Feldman mine, though operating on a rather small scale at present, is the largest producer of lode gold in the district. The work being done in 1916 was really in the nature of prospecting. The old tunnel on the Helen S. claim, described by Chapin,² from which the gold ore has been taken in the past, has been temporarily abandoned, and a new tunnel has been started on the Hiyu claim. The new tunnel is higher up the west slope of Moose Creek and is being driven along the continuation of the vein system, to determine the gold content of the veins, and in this way to learn whether it will pay to extend the old tunnel farther west.

The new tunnel was driven 350 feet on the gold quartz vein previously mined at the old tunnel. At this point a split in the vein

¹ Brooks, A. H., Antimony deposits of Alaska: U. S. Geol. Survey Bull. 649, 1916.

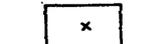
² Chapin, Theodore, Lode mining near Fairbanks: U. S. Geol. Survey Bull. 592, pp. 327-328, 1914.



TRUE N. 11.5' MAG. N.
APPROXIMATE MEAN DECLINATION, 1907


Intrusives


Placers


Metalliferous lodes

MAP SHOWING LODGE MINES AND PROSPECTS IN THE FAIRBANKS DISTRICT.

By L. M. Prindle, F. J. Katz, P. S. Smith, Theodore Chapin, A.H. Brooks and J.B. Mertie, Jr.

was encountered, and both branches of the vein have been followed for some distance. The leaner of these, about 10 to 12 inches thick, has a general strike of about N. 80° W. and a steep dip to the north. It was followed for about 150 feet to a point at which the vein strikes about N. 50° W. The other branch of the vein, which strikes N. 75° W. and dips steeply south, is considerably richer, though thinner, ranging from 4 to 6 inches in thickness. This higher-grade gold quartz vein at the time of the writer's visit had been followed 125 feet from the forks and is traceable at the surface northwestward for 2,000 feet from the mouth of the tunnel, extending into the Nars claim. Stibnite, arsenopyrite, and a little sphalerite occur with this gold quartz.

At the upper end of the Hiyu claim a vein of low-grade gold quartz about 2½ feet thick has been uncovered. This strikes about east and dips about 80° N. and should intersect the two veins above described. Kidneys of stibnite are present in the quartz.

MIZPAH.

The Mizpah mine was operated for several months in 1916, during which about 200 tons of ore was mined and milled. In the fall of 1916 the owner was preparing to continue mining operations on the property.

The Mizpah lode is a gold quartz vein which strikes from east to S. 70° E. and dips about 65° SW. It has been opened by an inclined shaft 120 feet deep and by tunnels driven east and west from the shaft. No drifting has yet been done at the bottom of the shaft, but the owner expects soon to sink the shaft 60 feet deeper and begin another tunnel. At the 80-foot level a tunnel has been driven 130 feet west along the vein and another has been driven 60 feet to the east. At 40 feet above and parallel with the west tunnel a stope has been driven 110 feet from the shaft.

The gold quartz vein is irregular, ranging in thickness from 3 inches to 3 feet, with an average thickness for the mine of about 1 foot. Horses are present at several places. Irregular veins of white vitreous quartz (bull quartz) also occur in the mine workings; but these are entirely barren of gold, except where they adjoin the true gold quartz veins and have been locally mineralized. In this mine the gold quartz vein may be seen definitely cutting the bull quartz, and this, in conjunction with the local mineralization of the bull quartz, is ample evidence that the gold quartz vein is the later.

About 1 foot of gold quartz is present at the face in the west tunnel, of which the 4 inches on the hanging wall is the richer in gold. At the west end of the stope, above the west tunnel, the face shows a vein split by a horse, the north side being about 12 inches and the south side about 6 inches thick. That part of the vein south of the

horse, or on the hanging wall, is of higher grade than the remainder of the vein. At the end of the east tunnel much faulting has taken place, and the gold quartz is replaced by earthy wad and oxidized silver-lead ore.

The gold is confined almost entirely to the quartz, but a little is present in gouge here and there along the walls. Stibnite occurs in some parts of the vein, and such parts assay abnormally high in gold, indicating gold enrichment by the antimony ore. Thus in the west tunnel, about 80 feet from the shaft, some stibnite is present in the gold quartz, and some ore yielding as much as \$2,000 to the ton is reported to have been mined. The average yield of the gold so far mined is between \$30 and \$40 a ton.

HOMESTAKE.

The Homestake mine was operated in 1916 by three lessees, and 80 tons of high-grade ore was mined. The most important recent development at this mine was the discovery by the laymen of another productive ore shoot in the vein from which the gold ore is now being taken.

The Homestake mine was visited by Chapin ¹ in 1913, and the lode system was described by him in considerable detail. At that time the main tunnel had been driven south about 750 feet, and a drift had been turned off to the east on the main gold quartz vein at a distance of about 320 feet from the tunnel entry. The gold appeared to be present in shoots which were separated by barren vein material. The drift intersected such an ore shoot, which had an east-west extent of about 160 feet. About 135 feet from the mouth of the drift, within this ore shoot, a raise to the surface demonstrated that the shoot ended not far above the drift, but a similar shoot was encountered 30 feet up the raise from the lower one. The operations during 1913 consisted largely in stoping and mining out these two ore shoots.

The present lessees have driven another raise near the east end of the main drift and have discovered a new ore shoot in the vein about 100 feet above the drift, from which ore is now being mined. To facilitate mining operations a new tunnel has been started up the hill and east from the old tunnel. This tunnel, however, if continued, would strike the vein below the new ore shoot, and therefore near the face a short inclined raise was driven east to the ore body.

Chapin ² described a horizontal fault in the main drift along which a general east-west movement had taken place parallel to the strike of the vein without displacing the vein. The owners of the mine in following east in the drift have determined that this horizontal fault

¹ Chapin, Theodore, Lode mining near Fairbanks: U. S. Geol. Survey Bull. 592, pp. 331-334, 1914.

² Idem, p. 333.

becomes curved. At the point where the new raise was driven the strike of this fault is N. 60° E. and the dip 30° NW. Other movements, however, have taken place in this vicinity, as shown by the presence at the east end of the drift of a fault striking N. 40° E. and dipping 58° NW., and the composite effect of the faulting is not altogether clear. The strike of the gold quartz vein at the new ore shoot is N. 68° E. and the dip 40° SW. This observation, in conjunction with those of Chapin, indicates considerable variation in the strike of the vein—perhaps as much as 25°

The country rock ranges from a mica schist to a quartzite schist and locally shows a jointing striking N. 65° W. and dipping 75° SW. The gold, however, is confined entirely to the quartz vein. Some stibnite is present in the mine, and pyrite and chalcocite were also seen in very small amounts. Much white vitreous quartz (bull quartz) occurs in the mine, but, as in the Mizpah mine, this is barren except where enriched by contact with the gold quartz vein.

MOHAWK.

The Mohawk lode is situated at the head of Eldorado Creek, at an elevation of about 2,150 feet, due south of the Newsboy mine. The mine was operated by two men for four months in 1916 but was closed at the time of the writer's visit on account of litigation. During the four months 46 tons of ore was mined and milled.

A working shaft about 50 feet deep has been sunk, from which two short tunnels have been driven west and east. The west tunnel, 25 feet long, intersects at its west end a vein of gold quartz, from 16 to 18 inches thick, which strikes N. 20° E. and dips 60° W. At the end of the east tunnel there is another vein, with the same strike and dip, ranging in thickness from 30 to 42 inches. These appear to be parallel veins, though it is possible that they may be faulted portions of the same vein. Both veins have been followed only a short distance. The gold is largely free. Stibnite, pyrite, and arsenopyrite in small amounts are also found in the vein. One of the owners, T. E. Winecoff, reports the presence of some osmiridium in the ore.

About 75 feet northwest of the working shaft another shaft, said to be 30 feet deep, has been sunk. This was filled with water and inaccessible, but it is reported to have uncovered another quartz vein, striking N. 80° W. and dipping 35° SW. The material on the dump at this shaft showed considerable arsenopyrite in the quartz.

NARS, ANDERSON & GIBBS.

No work was in progress at the property of Nars, Anderson & Gibbs in August, 1916, but it is reported by one of the owners that 100 tons of ore was mined sometime in 1916. The earlier work at this property and the character of the mineralization have been described in

some detail by Smith.¹ The working shaft was inaccessible at the time of the writer's visit, and no further information concerning the development work is available at present.

OHIO GROUP.

The Ohio group of claims, consisting of the Ohio, Mayflower, Early Bird, and Gray Eagle, lie along the north slope of Fairbanks Creek west of Too Much Gold Creek and east of the Mizpah lode. Mining at present is being done on a small scale, the work being more in the nature of prospecting than of mining.

A number of shafts have been sunk on the Ohio claim, exposing several gold quartz veins. Most of these shafts were examined by the writer, but it is difficult to correlate the different veins without a map showing the location of the shafts. Moreover, observations made in the shallow shafts are not trustworthy on account of surface creep, and at this locality the presence of an old creek channel along the hillside has induced creep in the bedrock at depth, rendering some of the information obtained in the deeper shafts likewise untrustworthy. However, it is apparent that a number of quartz veins are present, and the owners, recognizing the difficulty and uncertainty of prospecting along the hillside, have adopted the only alternative and are driving a tunnel from a lower elevation on the hill to crosscut the vein systems. This tunnel, which is to be 800 feet long, runs N. 30° W., and in August, 1916, had been driven 240 feet. Not only will this tunnel be a means of prospecting all the veins, but it will also afford an easy outlet for the ore to the mill on the property.

Several shafts on the Ohio claim were examined. One of these, 25 feet deep, showed two quartz stringers, close together and coalescing in places, with a general strike of N. 70° W. and a dip of 45° SW. This quartz is commercial ore.

Another shaft, 57 feet deep, has exposed 8 inches of low-grade gold quartz, averaging perhaps \$4 to \$5 to the ton. This vein strikes east and dips about 45° N.

From the bottom of a third shaft, 70 feet deep, a drift 70 feet long has been driven, starting east and then turning north. In this drift is exposed a gold quartz vein, 4 to 6 inches thick, which strikes east and dips 45° NW. A shattered and iron-stained ledge of the bull quartz is also exposed, but this appears to be barren of gold. It is clear here, as at the Mizpah and Homestake mines, that the auriferous quartz is later than the barren bull quartz. The gold quartz exposed in this shaft is good commercial ore. It contains also pyrite and stibnite.

Higher up the slope, on the Ohio claim, a 30-foot shaft has exposed a body of "base" ore, the exact extent of which is not known. A

¹ Smith, P. S., Lode mining near Fairbanks: U. S. Geol. Survey Bull. 525, p. 155, 1913

piece of rock from the bottom of the shaft appears to be a recrystallized rock of a green color and impregnated with quartz, pyrite, and arsenopyrite. A globule of silver is reported to have been obtained from some of the oxidized ore, which resembles very much the silver-lead ore in the Mizpah lode.

On the Early Bird claim 12 to 15 inches of stibnite in a kidney-shaped body was uncovered in a 25-foot shaft.

Gilmore & Stevens, owners of the Ohio group of claims, installed in 1915 a 5-stamp mill, in which 800 tons of ore has been milled. Of this amount 350 tons has been taken from the gold quartz veins on the Ohio group, most of which was milled in 1915. At present the owners are engaged chiefly in driving the tunnel above described.

CENTER STAR.

The Center Star claim, on Skoogy Gulch, a tributary of Twin Creek, was worked during 1916. The ore was milled on the ground by a home-made single-stamp mill, driven by a 6-horsepower gasoline engine.

A shaft about 45 feet deep has been sunk, at the 35-foot level of which drifts have been driven 25 feet to the west and 150 feet to the east. The gold occurs in a 3-inch stringer of quartz, which strikes N. 85° W. and dips steeply to the south. The country rock is a quartzite schist, barren of gold. The gold ore is of high grade.

ST. PAUL.

The St. Paul claim, near the head of Eva Creek, southeast of Ester Dome, was actively prospected during the spring and the early part of the summer of 1916, and late in the summer a 7-foot roller mill, with a capacity of 20 tons in 24 hours, was installed. This mill is equipped with an inside amalgamator and is run by a 30-horsepower boiler. During the remainder of the year 370 tons of ore was milled.

The workings consist of a 15-foot shaft, from the bottom of which a 15-foot inclined shaft was driven to prospect the ore, and a main tunnel, starting at a lower elevation than the shaft and driven 227 feet, meeting the bottom of the shaft.

The lode on the St. Paul claim is of considerable interest, because it illustrates a phase of the gold mineralization different from that seen at most of the lode mines in the Fairbanks district. The gold lode material is a 3-foot vein of the massive white vitreous quartz usually found to be barren of gold in the district. This vein is irregular in thickness, strikes generally about N. 40° E., and dips 38° NW. The quartz is greatly decayed, shattered, and iron stained, as is also the quartzite schist and mica schist country rock. There is said to be from 8 to 10 inches of ledge matter on the foot-wall, and about 6 inches of the same on the hanging wall. Irregular

bodies of stibnite and its alteration products occur along the foot-wall, but the gold content is said to be lower near this stibnite. At the face of the tunnel, in August, 1916, a fault had been encountered, and the width of the ore body was reduced to a few inches.

It is perfectly clear that this is not true gold quartz, similar to that in most of the Fairbanks mines. The gold mineralization is clearly a feature of later age than the formation of this body of shattered quartz. The writer's interpretation of this lode is that it represents a deposition of gold from solution with little or no accompanying gold quartz. It is believed that the 3-foot vein of quartz in the St. Paul lode bears no genetic relation to the gold, being probably an old barren quartz vein, similar to hundreds of other such bull quartz veins in the Birch Creek schist. The localization of the gold in this quartz was more likely due to a mechanical cause, as the quartz on account of its brittleness was extensively broken and shattered in earth movements prior to the injection of the mineralizing solutions, to which it therefore offered channels of easy circulation. It is also possible that the quartz, on account of its siliceous nature, may have influenced the deposition of the gold. The fact to be emphasized, however, is that this material does not resemble the ordinary Fairbanks vein quartz, either in appearance or in manner of occurrence. The writer was rather impressed by the resemblance of this lode system to the normal type of gold lodes in the Nome district; but the St. Paul lode differs from the gold lodes on Seward Peninsula in that the gold here is largely free.

The deduction to be made from these considerations is that the quartz in the St. Paul lode is likely to be irregular, in a degree corresponding to the irregularity of the old series of barren quartz veins. The quartz is indeed likely to be discontinuous or to disappear entirely, though the lode may continue as a fault zone in the schist, with or without true gold quartz. The absence of vein quartz is not in itself to be considered detrimental to the future of the lode. The mistake to be avoided is that of following blindly the quartz as a source of gold, for the deposition of the gold in a body of quartz was in all probability fortuitous and not to be ascribed to generic association. The direction of the zone of faulting, indicated by the maximum of shattering and iron staining, should determine the continuation of the lode.

INDEPENDENCE.

The three claims that constitute the Independence group are staked end to end in an east-west direction on the east slope of Twin Creek, just below the mouth of Skoogy Gulch. Independence claim No. 1 crosses Twin Creek and extends some distance up the west slope. The lode was discovered in 1915, and the development work

was done for the most part last winter. Mill runs on the ore have been made in an arrastre built on Twin Creek.

The Independence lode is a mineralized zone in porphyritic granite, extending in a general easterly direction. Two small tunnels have been driven on the east slope of Twin Creek on Independence claim No. 1, in the upper of which 18 inches of vein quartz is exposed. This vein strikes east and dips 90° . Many iron-stained joint planes carrying gold are present in the surrounding country rock. Some of these lie at right angles to the strike of the veins, but others are irregular. Many small quartz veinlets, likewise irregularly placed, also carry gold. The quartz veins and stringers in this lode are high-grade ore, and the rock on the dump may be considered as workable commercial ore. The granite on both sides of the zone of intensive mineralization gives low assays in gold, but it is not known yet how far on each side rock of this sort extends. The mineralized zone has been traced at the surface for 900 feet east from the tunnels.

Considerable pyrite and arsenopyrite occur with the gold quartz, and both these minerals carry gold, probably for the most part in a finely divided condition. About one-third of the gold is said to be recoverable when the ore is crushed to 40 mesh, the remaining two-thirds being contained in the sulphides.

GOESSMANN.

The Goessmann claims have been described in some detail by Smith,¹ under the head of the Tanana Quartz & Hydraulic Mining Co.'s claims. They consist of nine claims on the east side of Bedrock Creek, just above its junction with Cleary Creek. No work was in progress at the time of the writer's visit, and no further description of the property will be given here.

McCARTHY.

The McCarthy claims are in the saddle that separates Fairbanks and Wolf creeks on the Fairbanks slope. Nine claims constitute the group.

The latest work done on these claims is on the Pioneer claim near its center, where two shafts have been sunk on an antimony lead. The vein varies considerably in thickness, averaging perhaps 18 inches. The strike is N. 85° E. and the dip is about 80° N.

About 500 feet to the west, on the Pioneer claim, three gold quartz veins have been uncovered. One of these is 12 inches in thickness, strikes N. 45° E., and dips 60° NW.; another, 35 feet farther west, is 14 inches thick, strikes N. 35° E., and dips 80° NW.; the third, still farther west, is 6 inches thick, strikes east, and dips 45° S. It is reported that these three veins will average \$10 to the ton.

¹ Smith, P. S., Lode mining near Fairbanks: U. S. Geol. Survey Bull. 525, pp. 180-182, 1913.

On the Iron Mask claim and continuing west into the Pioneer, a vein of stibnite 8 inches thick has been discovered, which strikes N. 80° W. and dips about 75° S. Near by, also on the Iron Mask, there is a large vein of low-grade gold quartz, striking N. 42° W. and dipping 70° N. This vein, which is about 4 feet thick, is reported to intersect and therefore to be younger than the stibnite vein above described. This large vein of low grade gold quartz also carries stibnite, and both this and the other stibnite on the Iron Mask pan gold. The large quartz vein has been traced southeastward to Fairbanks Creek, and the ore in that direction is said to become of higher grade.

MONTE CRISTO AND GRANITE HILL.

The Monte Cristo claim is on the spur between Melba and Monte Cristo creeks. The development work to date consists of a shaft 18 feet deep, now caved.

This is an interesting lode because of its obvious genetic connection with a body of porphyritic biotite granite, which forms the country rock at this locality. According to a description given by the owner two quartz veins separated by about 3 feet of shattered granite were exposed in the shaft. The strike of these veins is said to be N. 5° W. and the dip 80° W. The east vein has a thickness of 3 to 4 inches and was uniform to the bottom of the shaft; but the west vein, though 18 inches thick at the surface, pinched out a few feet from the bottom.

The quartz contains gold, scheelite, bismuthinite, and according to assay some mineral containing tellurium. A feature worthy of particular mention at this shaft is the apparent independence of gold and tungsten in the lode. The gold is associated with the bismuth and tellurium, being in fact intergrown with the bismuth minerals. The scheelite, on the other hand, is said to occur in portions of the vein where gold is absent. This condition is exactly in accord with that found in the scheelite lode on the Black Joe and Mizpah claims.

On the Granite Hill claim, adjoining the Monte Cristo, is another bismuth-bearing gold quartz vein, which has previously been described by Chapin.¹ No recent work has been done on this claim.

SMITH & McGLONE.

A number of gold quartz claims on the ridge between Eva and St. Patrick creeks are owned by Smith & McGlone and are being intensively prospected. Shafts have been sunk on several gold quartz veins, some of which, now inaccessible, have been described by Chapin.² The owners have by this time a fairly good idea of the mineralization of their claims, and when the inevitable revival of lode

¹ Chapin, Theodore, Lode mining near Fairbanks: U. S. Geol. Survey Bull. 592, pp. 330-331, 1914.

² Idem, pp. 354-355.

mining begins in the Fairbanks district, they should be in a good position to begin active work.

The present work is being done on the Leah fraction. A 95-foot shaft has been sunk, showing a vein of gold quartz from 2 to 3 feet thick, lying in and parallel with a mineralized zone from 3 to 11 feet wide. The strike of the vein is N. 45° E. and the dip 55° SE. Both the gold quartz and the white vitreous bull quartz were seen in the mineralized zone, but here, as at the St. Paul claim, the bull quartz is mineralized. A specimen taken by the writer shows some of this vitreous quartz, much broken and shattered, filled with stibnite, proving the later character of the mineralization. A little sphalerite is also present in this lode. That portion of the lode which adjoins the quartz vein proper is much shattered and filled with quartz stringers. This part of the lode, though not as high-grade ore as the main quartz vein, also carries gold and may probably be worked. The gold quartz proper is good commercial gold ore. It is reported to the writer that the gold content is higher where stibnite is present in the lode.

RYAN.

Prospecting continued in 1916 on the Ryan group of eight claims at the head of St. Patrick Creek. The present workings consist of a shaft 28 feet deep, sunk on the side line between the Monte and Eva claims, which has exposed a large body of quartz.

The lode consists of a shattered mixture of quartz and country rock, lying in a zone which strikes N. 25° E. About 15 to 20 feet of ore was exposed at the time of the writer's visit. This is evidently another mineralized zone, comparable in character with that seen at the St. Paul claim. The mineralization has seemingly occurred along a zone of fracture and is not confined to a gold quartz vein. Much arsenopyrite is present in the lode, and the green alteration product scorodite extensively colors the lode material.

On the Ryan claim a shaft has been sunk 35 feet, at the bottom of which there are kidneys of quartz lying in a mineralized zone of schist. As at the other shaft, much arsenopyrite is present. It is said that the gold content is higher where there is the least arsenopyrite, but the suggestion is advanced that the arsenopyrite itself may contain gold that is not free. Kidneys of stibnite also are present in the gouge.

TYNDALL & FLYNN.

The Bondholder group of claims, owned by Tyndall & Flynn, is near the head of Gold Gulch, a tributary of St. Patrick Creek. The mineralization on the Bondholder claim has been described by Chapin,¹ who says that a lode which strikes N. 20° E. and dips 40° NW. has

¹ Chapin, Theodore, *op. cit.*, p. 355.

been traced for 500 feet on the surface and across the length of three adjoining claims to the northeast. This lode is 6 feet wide and is composed of quartz with inclusions of schist. The hanging wall is bounded by gouge, and along this side of the vein the richest ore occurs in a green-stained quartz stringer. The footwall is not well defined, being made up of a number of parallel joint planes, each with a narrow seam of gouge.

The lode on the Bondholder claim has been prospected by three shafts, one 140 feet deep, another 145 feet deep, and a third shallow shaft. All these are now in poor condition. Ore from this lode, seen by the writer, resembled to a marked degree the ore on the Ryan lode, containing arsenopyrite and the green alteration product scorodite. This is reported to be high-grade commercial ore.

A tunnel has been started on the Yellowjacket claim, east of the Bondholder, and is being driven to crosscut the Bondholder lode. Between 600 and 700 feet of tunnel has been driven, but the lode had not yet been reached in August, 1916. This tunnel shows many well-developed joint planes in the schist country rock, which strike N. 20° W. and dip 85° E. Near the face many horizontal or nearly horizontal faults occur, and one small seam of quartz and calcite, carrying some pyrite, was noted.

On the Mohawk claim, also owned by Tyndall & Flynn, two shafts 40 feet deep have been sunk, exposing an 8-foot vein of quartz, with little or no gouge. Stibnite and a little sphalerite are contained in the quartz. It is probable that this is a continuation of the lode now being prospected on the Leah fraction by Smith & McGlone.

OTHER MINES AND PROSPECTS.

There are a large number of other gold quartz mines and prospects in the Fairbanks district; but on account of present conditions a number of gold quartz mines are not being operated, and prospecting is not being prosecuted very actively. The omission of reference to gold quartz mines and prospects, which have been described in earlier reports is to be considered only as an evidence of lack of mining activity and not as an indication of lack of intrinsic worth.

SULPHIDE ORES.

A variety of metallic sulphides have been discovered in the Fairbanks district, including stibnite, galena (in part silver-bearing), pyrite, arsenopyrite, sphalerite, bismuthinite, jamesonite, chalcocite, and tetrahedrite. Of these only stibnite and galena have been found in lodes of commercial importance.

A number of antimony mines were operated in 1916; but all of them except the Chatham mine were closed in August. Stibnite

is known to have been mined at the Chatham mine, the Black Eagle mine, the Hindenburg claim, and at the Leindecker property.

One silver-lead lode, near the head of Cleary Creek, was worked by the Eldorado Mining & Milling Co.

CHATHAM.

The Chatham mine, near the head of Chatham Creek, is in reality a gold mine; but during the season of 1916 it was worked for the antimony ore which it contained and hence the 2-stamp mill on the property was idle.

The main tunnel has been driven 1,300 feet; but the present work in the mine is being done largely in a stope above the tunnel, about 850 feet from the entry. A raise has been driven 100 feet to the surface, and 60 feet above the tunnel in this raise is the stope from which the antimony ore is being removed. The vein, which is about 18 inches thick, is almost vertical and strikes N. 70° E. Several feet of gouge lies along the footwall, usually the south side of this vein, but the hanging wall is firmer. The ore is stibnite. This vein is said to cut the main gold quartz vein of the Chatham mine at an angle of 85°.

About 20 feet from the raise a shaft has been sunk 32 feet from the floor of the tunnel, striking the stibnite vein below. Mining is also being carried on at the bottom of this shaft, but pumping is necessary.

HINDENBURG.

The Hindenburg claim, at an elevation of about 1,600 feet on the divide between Spruce and Eldorado creeks, was worked for stibnite during the summer of 1916 by Poz & Contardi, but the mine was idle at the time of the writer's visit in August. Seven or eight men were employed during the early part of the summer. It is reported that 200 tons of ore was shipped from this property.

The workings consist of a shaft 25 feet deep, with drifts from the bottom. The ore body is said to lie nearly flat, dipping about 60° SE.

BLACK EAGLE.

The Black Eagle mine, on Eagle Creek, a southwesterly tributary of Treasure Creek, has been described in some detail by Brooks.¹ This property was closed and was not visited by the writer. It was the largest producer of stibnite in the district in 1916.

LEINDECKER.

On the Leindecker property, at the head of Too Much Gold Creek, no operations were in progress in August, 1916.

¹ Brooks, A. H., Antimony deposits of Alaska: U. S. Geol. Survey Bull. 649, pp. 28-29, 1916.

ELDORADO MINING & MILLING CO.

The Eldorado Mining & Milling Co. is working a lode on two claims on the southeast side of Cleary Creek, just above the mouth of Willow Creek. This is the only silver-lead lode in the district that is being worked at the present time.

An open cut and a 40-foot shaft are the principal workings. The country rock is a fine-grained quartzite, and the vein as exposed in the open cut ranges in thickness from 3 to 12 inches and lies parallel with the structure of the country rock. The ore at present being mined is argentiferous galena with considerable pyrite. The value of the ore taken from the shaft, as given to the writer by one of the lessees, classes this as a good commercial ore of silver and lead. The ore also carries a little gold.

JACKSON.

The Jackson claims consist of the Little Jim, Big Jim, Our Jim, and Your Jim, near the top of the spur between Bedrock and Tamarack creeks; and the Vergil and Wolverine, near the top of the spur between Willow and Bedrock creeks. The Jim claims are here described under the head of sulphide lodes, though they also contain gold. Prospecting has been carried on intermittently on these claims for several years.

The lodes on the Jim claims contain a variety of minerals, including stibnite, silver-bearing galena, pyrite, arsenopyrite, and gold both in the free state and combined with the sulphides. Chapin¹ has described the character of the lodes, and the writer in this report will sketch only the developments in prospecting, reserving for a later paper the description of certain interesting features of the ores on this property.

The Little Jim claim is the same as that described by Chapin as the Silver King. An open cut 50 feet long on this claim has exposed a 2-inch vein of sulphide ore, largely galena with some stibnite, which strikes east and dips about 25° S. The country rock is mica schist and both walls lie parallel to its schistosity. Both the vein and the country rock are cut by a fault that strikes N. 75° W. and dips 90°. About 25 feet south of the open cut a shaft is being sunk to intersect the lode. This ore also contains pyrite and is reported to carry considerable silver.

Another open cut on the Little Jim claim, about 250 feet northeast of the cut just described, has exposed a flat-lying seam of sulphide ore, which contains well-formed crystals of quartz intergrown with the sulphide. This vein where observed by the writer is about 4 inches thick, strikes N. 45° E., and dips at a low angle to the south-

¹ Chapin, Theodore, Lode mining near Fairbanks. U. S. Geol. Survey Bull. 592, pp. 338-339, 1914.

east. The ore is described by Chapin¹ as being essentially a sulphantimonate of lead, probably jamesonite, but it contains also galena, arsenopyrite, pyrite, and possibly stibnite. Both walls lie parallel with the schistosity of the country rock, which for 6 or 7 inches on each side of the vein is heavily iron stained and carries from \$6 to \$7 a ton in gold. The sulphide ore carries considerable silver.

A shaft has been sunk to a depth of 60 feet on the corner between the Little Jim, Your Jim, and Our Jim claims. A drift started about 25 feet south of that point has exposed a vein of sulphide ore, composed of galena and arsenopyrite with a little pyrite, which strikes N. 45° E. and dips about 45° SE. This vein cuts the cleavage of the country rock. A short distance away, on the Big Jim claim, a flat-lying antimony vein was encountered. The shaft and drift by which this was prospected are now caved.

A tunnel 516 feet long has been driven, starting on the Big Jim claim, following the line between the Our Jim and Your Jim claims, and ending at the northwest corner of the Little Jim claim. A number of faults are apparent in this tunnel, most of which have a strike somewhat north of west. At 70 feet from the entry a fault striking N. 45° E. and dipping 65° NE. cuts across the tunnel. At 123 feet from the entry is another fault, striking N. 75° W. and dipping 75° S. At 200 feet is a third fault, which strikes N. 75° W. and dips 65° S. At 300 feet is exposed a fourth fault plane, likewise striking N. 75° W. and dipping steeply south, along which there is about 4 inches of crushed vein material and gouge that contains sulphides carrying gold. Several faults occur 380 feet from the mouth of the tunnel, and along one of them, striking N. 40° W. and dipping 45° N., is 18 inches of soft gouge, which is reported to yield a small amount of silver. Much faulting has occurred at the rear of the tunnel, and some of the faults are curved. The country rock is quartzite, quartzite schist, and mica schist. The area included in these Jim claims has evidently been a center of dynamic disturbances and mineralization.

A shaft 14 feet deep with a drift extending 4 feet south from the bottom has been sunk on the line between the Vergil and Wolverine claims. The ore consists of iron-stained country rock impregnated with quartz and antimony ore, in a mineralized zone about 8 inches wide, striking N. 55° E. and dipping 15° SE. The hanging wall is quartzite schist and the footwall mica schist. A fault striking N. 80° W. and dipping 70° S. is present in the bottom of the shaft, but this appears to be earlier than the mineral injection, for it does not displace the ore.

The ore is stibnite with several oxidation products and is reported to carry both gold and silver.

¹ Chapin, Theodore, *op. cit.*, pp. 338-339.

TUNGSTEN LODES.

GENERAL FEATURES.

The Geological Survey has known for a number of years that tungsten lodes were present in the Fairbanks district, for tungsten minerals have been found in the gold placers on several creeks. Thus in 1909 Johnson,¹ in summarizing the known occurrences of tungsten minerals in Alaska, referred to the discovery by L. M. Prindle of wolframite on Fairbanks and Little Eldorado creeks. The concentrates from Fairbanks and Fish creeks are known to carry scheelite, and it is probable that close examination may show tungsten minerals in numerous other creeks.

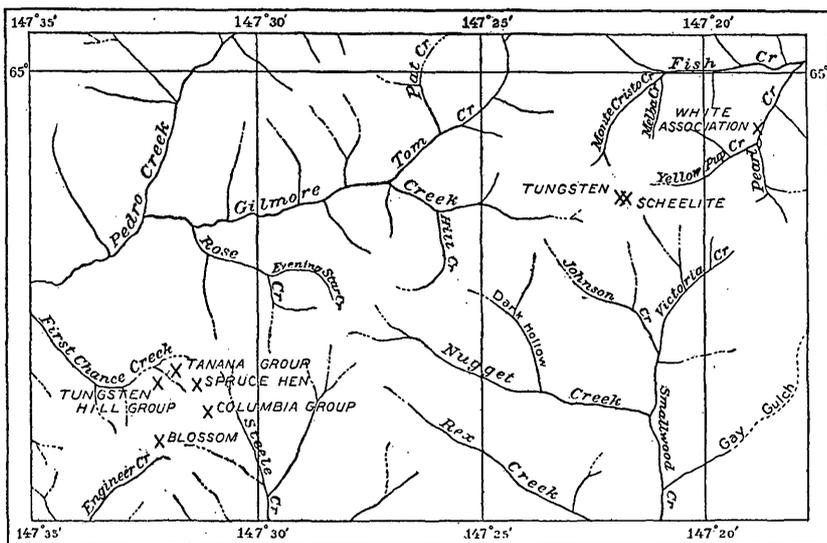


FIGURE 8.—Sketch map showing tungsten lode claims in the Fairbanks district.

During the summer of 1915 the bedrock source of some of these tungsten minerals was discovered, and tungsten lodes became another of the mineral resources of the Fairbanks district. Prospecting has centered chiefly at two localities, one on the ridge between Fish and Smallwood creeks and the other on the ridge at the heads of First Chance, Steele, and Engineer creeks. Two workable scheelite lodes have been opened at the former locality, and a number of promising occurrences of scheelite are being prospected at the latter. In addition, a small lode on Fairbanks Creek was worked.

The following description of the scheelite lodes is intended mainly as a report of progress. A later report, dealing with the tungsten deposits of Alaska, will give more detailed information regarding the lode systems and their genesis. Figure 8 shows the distribution of the tungsten lodes in the Fairbanks district.

¹ Johnson, B. L., Occurrence of wolframite and cassiterite in the gold placers of Deadwood Creek, Birch Creek district, Alaska: U. S. Geol. Survey Bull. 442, p. 246, 1910.

TUNGSTEN.

The Tungsten claim, owned by George Ewers, is on the divide between Fish and Smallwood creeks, on a prominent dome at the heads of Melba and Monte Cristo creeks. Scheelite was discovered on this claim in the summer of 1915, and mining was begun in the fall of that year and continued into the summer of 1916. In August, 1916, an 18-horsepower gasoline engine and an air compressor had been ordered, and the owner was preparing to put in a track, install a skip, and begin operations on a larger scale.

The development work up to August consisted of an 80-foot incline, at an angle of about 33° ; a 35-foot drift to the east about 50 feet down the incline; and another drift some distance to the east at the bottom of the incline. It was from this lower drift that the latest shipment of ore was mined.

The country rock at the Tungsten, as well as at the adjoining Scheelite claim, consists largely of crystalline limestone, extensively silicated at certain horizons. Such silicated rocks have been described by Prindle¹ under the designation "silicated limestone." His conclusion regarding the origin of these rocks is as follows: "The most probable tentative explanation is that these rocks were impure calcareous sedimentary rocks containing basic or interbedded tuffaceous material, and that they were metamorphosed while they were deeply buried."

The silicated portions of the country rock at the Tungsten and Scheelite claims contain calcite, pyroxene, hornblende, and quartz. Thus there are pyroxene-quartz, hornblende-quartz, and pyroxene-calcite rocks, as well as rocks of intermediate type. One specimen of a pyroxene-calcite rock shows the two minerals in poikilitic intergrowth. Hornblende schist and mica schist also occur in the near vicinity. It is believed that the recrystallization of the country rock to its present condition was quite independent of any effect of the ore-bearing solutions—that is, the alteration of the country rock appears to be due to regional and not contact metamorphism.

The scheelite occurs as disseminated deposits in mineralized zones or as ore shoots in the country rock. In the drift that starts 50 feet from the surface several tons of ore was removed from a small ore shoot about 12 inches high and 18 inches across. The strike of this shoot was about N. 60° E., and the dip 25° NW. At the bottom of the shaft, another ore shoot, nearly horizontal, was opened. This body of ore 10 feet from the shaft is 7 feet wide and 8 feet high, but at the east end of the drift in August it is 4 feet wide and 6 feet high, apparently trending about east. The cleavage of the country rock dips 33° N., the same direction and pitch as that of the shaft. The

¹ Prindle, L. M., Geology of the Fairbanks district, Alaska: U. S. Geol. Survey Bull. 525, pp. 62-64, 1913.

first shipment of ore from the mine was taken from the inclined shaft, and it appears therefore that the ore-bearing solutions in that locality followed the rock cleavage. Ore deposition in general has probably been guided by the facility of circulation afforded by the country rock.

The rock that contains the scheelite is of particular interest, on account of the bearing which its character has on the genesis of the deposit. One specimen of ore examined under the microscope is composed of quartz, augite, scheelite, apatite, and chloritized biotite. A small amount of uralitic hornblende also is present, derived probably from the altered pyroxene. The scheelite occurs as euhedral crystals and appears to be secondary with respect to other rock minerals.

Another specimen, taken from the shaft by Mr. Johnson, a former part owner of the Tungsten claim, is apparently a tungsten-bearing pegmatite. The rock-forming minerals are quartz, oligoclase, scheelite, apatite, titanite, and a little biotite and hornblende, both chloritized. A small amount of sericite, apparently derived from the feldspar, is also present. The scheelite has developed as euhedral crystals, which contain anhedral inclusions of quartz and oligoclase, together with euhedral inclusions of apatite. The exact spot in the shaft from which the specimen was taken was not discovered by the writer, but it was assuredly an integral part of the deposit.

The Tungsten and Scheelite claims are about a third of a mile from a large body of porphyritic granite to the south and about two-thirds of a mile from a smaller body of similar intrusive rock to the north. Without much doubt these two bodies of granite ore are connected beneath the surface and therefore underlie this deposit of scheelite at no great depth. These data, taken in connection with the presence of the scheelite-bearing pegmatite above described, show the intimate genetic connection between the intrusive rock and the tungsten ore. This deposit of scheelite, then, particularly near the surface, where it is at present being worked, is a disseminated deposit, the tungsten-bearing solutions having been derived from a near-by granite magma. Mining operations closer to the igneous rocks may show the presence of definite contact-metamorphic deposits.

Fifty tons of scheelite ore was mined and shipped in the form of scheelite concentrates from the Tungsten claim in 1915, and 160 tons was mined, concentrated, and shipped in 1916. The ore was hauled to the Heilig custom mill on Fairbanks Creek for concentration and was afterward shipped by parcel post.

SCHEELITE.

The Scheelite claim lies immediately east of the Tungsten claim, and the mining and geologic conditions are identical at the two

claims. The development work consists of a 75-foot inclined shaft along the cleavage of the country rock, which, though irregular, strikes in general about N. 70° E. and dips 33° N. The ore shoot which is followed by the inclined shaft, is 10 feet wide and from 4 to 6 feet high.

No mining was in progress at the time of the writer's visit, but 250 tons of unconcentrated scheelite ore was shipped to Tacoma, Wash., from the property during the winter of 1915-16. In August, 1916, the owner was preparing to sink a 100-foot vertical shaft and continue mining operations.

WHITE ASSOCIATION.

The White association consists of three placer claims on Pearl Creek, extending downstream from the mouth of the Yellow Pup. In addition to placer work, the owner has recently been prospecting at this locality for lode deposits of tungsten minerals.

Three shafts have been sunk, one to a depth of 30 feet, but these were not accessible when the property was visited. According to a description given by the owner, an ore shoot of scheelite has been located in the country rock, which is hornblende schist and mica schist. The strike of this body of ore is said to be N. 75° E. and the dip about 75° N. The schist has apparently been impregnated with scheelite along its schistosity. As might be expected, the concentrates from the placers on Pearl Creek contain scheelite.

BLACK JOE AND MIZPAH.

Scheelite was mined in 1916 by Ott & McGowon at the Black Joe and Mizpah claims, on Fairbanks Creek, adjoining the Mizpah mine. Work at this property had been discontinued at the time of the writer's visit. The development work consists of an inclined shaft, 90 feet deep, with drifts at the 60 and 80-foot levels.

The country rock is quartzite schist, which strikes N. 20° W. and dips 18° SW. The scheelite is present in a quartz vein, which cuts the cleavage of the schist, striking N. 80° W. and dipping about 80° S. This is really a gold-tungsten vein, for it contains both gold and scheelite. The interesting feature, however, is that the two minerals occur in different portions of the vein. Just above the 60-foot level the vein is 6 inches thick and is a gold-quartz vein, carrying little or no tungsten. Just below this level, in the same vein, the quartz is scheelite-bearing and the gold is lacking. In reality, there is a scheelite ore shoot in the quartz, with a lateral extent along the vein of about 80 feet. At the 80-foot level the vein is a low-grade gold-tungsten lode, carrying little gold and much less scheelite than at the 60-foot level. The dip of the vein at this point ranges from 45° to 85° S. It appears, therefore, that where this quartz vein carries scheelite in commercial amount gold is lacking, and that the gold-bearing part of the vein is lacking or low in scheelite.

TANANA GROUP.

The Tanana group consists of five lode claims along the northeast side of Tungsten Gulch, a headwater tributary of First Chance Creek. The claims are owned by Grant & Hirschberger, and during the summer of 1916 were being actively prospected for scheelite. Six scheelite lodes have been discovered on these five claims, and others are probably present.

The principal work has been done on the Tanana No. 1 claim. The country rock on this claim is a quartzite schist, the cleavage of which strikes N. 30° E. and dips 35° NW. The lode consists of a mineralized zone, 3 feet thick, which lies parallel with the major structure of the country rock. It is the structure of the schist, in fact, which has determined the site of the ore deposition. The scheelite occurs in stringers of soft, decomposed, iron-stained schist, from 2 to 6 inches in width. Many of these stringers contain little quartz-scheelite veinlets, which are very rich in tungsten and carry also some gold. The stringers of decomposed schist are said to carry both scheelite and gold. The country rock separating the schist stringers in the lode also carries a little scheelite, possibly as much as 1 per cent. A specimen of scheelite-bearing pegmatite, taken from the bottom of the incline, shows the intimate genetic connection of the deposit with granitic rocks.

A gold quartz vein striking N. 8° W. and dipping 60° E. cuts the schist and the scheelite lode above described. This vein carries gold in about the same amount as the scheelite lode. In view of the fact that gold and scheelite do not appear to have been deposited synchronously at the other properties visited, it is probable that the gold in this scheelite lode is a result of local enrichment by the gold quartz vein. Both structural and mineralogic data therefore point to the conclusion that the scheelite mineralization took place before the formation of the gold quartz veins, at least at this particular locality.

The Discovery lode on the Tanana No. 1 claim consists of 8 feet of scheelite-bearing schist, exposed in an open trench. The hanging wall at this place is porphyritic granite.

The Tanana group of claims, as well as the other claims in this vicinity, including the Spruce Hen group, the Columbia group, the Tungsten Hill group, and the Blossom claim, lie along the western periphery of a large intrusive mass of porphyritic granite. This is the same body of granite that lies north of the Tungsten and Scheelite claims, above described. The granite is intimately associated with the scheelite lodes, being present at the different claims as transverse dikes or wall rock, and in the Tanana No. 1 lode a scheelite bearing pegmatite occurs. It is quite evident, therefore, that the scheelite deposits at the west end of this intrusive mass are dissem-

inated stringer lodes, much like the lodes at the Scheelite and Tungsten claims. Differences in the form of the deposits are due largely to the differences in the character of the country rock.

SPRUCE HEN GROUP.

The Spruce Hen group consists of three claims on the divide between First Chance and Steele creeks. These claims are being prospected by J. F. Zimmerman.

Five lodes are said to be present on the Spruce Hen claim. These are being prospected by open trenches. One trench has revealed a uniformly mineralized body of schist and metamorphosed basic intrusive rock, without any stringers or veinlets, from 3 to 4 feet wide, averaging perhaps from 1 to 2 per cent of scheelite. This lode carries no gold.

At another trench, on the same claim, is exposed a 4-foot lode of similar character which strikes N. 33° E. and dips 40° NW. This strike is conformable with that of the country rock on the Tanana No. 1 claim, and it is not improbable that this trend of the country rock has been determined to some extent by the intrusion of the neighboring granite mass, one tongue of which extends from the main mass in a northeasterly direction along the ridge.

COLUMBIA GROUP.

The Columbia group, comprising three claims, is at the head of Steele Creek, southeast of the Spruce Hen group. These claims are owned by J. Meier, J. Hoffmann, and W. Wallace. At the time of the writer's visit to this property, the development work consisted of a short tunnel at one locality and an open cut at another. Since that time, however, the tunnel has been driven 130 feet, and in midwinter the owners were installing a small mining plant.

The open cut is on the Columbia claim and has exposed a scheelite lode similar to the others previously described, cut by a 1-foot vein of quartz. Considerable wad is associated with the quartz, showing that the vein is to be classed with the gold quartz veins.

In the tunnel a 3-foot zone of scheelite-bearing rock was exposed. The hanging wall is a porphyritic granite, and the lode material consists of decayed stringers of country rock, rich in scheelite, similar to those at the Tanana No. 1 lode. The strike of the lode system is N. 20° W. and the dip 30° E.

TUNGSTEN HILL GROUP.

A group of eight claims, owned by Martin Harrais and known as the Tungsten Hill group, lies on the southwest side of Tungsten Gulch, a tributary to First Chance Creek.

Four scheelite lodes had been discovered on these claims by August, 1916, and it is likely that others are present. On the Grand Duke Nikolas claim a scheelite lode in the schist country rock had been exposed in an open cut. This deposit consists of 6 to 8 feet of decayed schist, carrying scheelite. Vein quartz containing a little gold is also present, cutting the mineralized zone.

On the Tungsten No. 1 claim another open cut had been made in a country rock of mica schist and quartzite schist. A zone mineralized by scheelite is present, but the width of the lode was not apparent from the work done.

On the General Joffre claim a scheelite lode, 14 feet wide, has been exposed. The lode as a whole was considered low-grade ore; but it contains in the central part an 18-inch stringer of decayed schist, which is of considerably higher grade.

These claims certainly deserve further prospecting, for they are as advantageously situated with regard to the granite as other scheelite claims in the district on which workable lodes have been developed.

ANDERSON CLAIM.

A lode claim adjoining the General Joffre claim, of the Tungsten Hill group, is owned by Charles Anderson. On this claim a quartz stringer striking N. 50° E. and dipping 55° NW. has been exposed in an open cut. The foliation of the country rock, which is largely a mica schist, strikes N. 60° E. and dips 20° NW. Scheelite is reported to be present along the outer edges of this quartz vein, but none is reported either inside the vein or in the adjoining country rock. It is likely that this quartz vein was formed first, and that at some later time the scheelite-bearing solutions percolated upward along the sides of the quartz and deposited scheelite in its present position.

BLOSSOM GROUP.

The Blossom group consists of several claims belonging to Victor Lundbled and Charles Anderson, at the extreme head of Engineer Creek.

A shaft on the Blossom claim is said to have exposed a rich stringer of scheelite, but this was not visible on account of timbering in the shaft. A granite porphyry dike is present in the bottom of the shaft.

At another claim of the Blossom group a shaft 20 feet deep has been sunk, opening a scheelite lode from 3 to 4 feet in thickness. This is another lode of the stringer type, but a thin quartz veinlet a short distance from the shaft was reported to carry 40 per cent of tungsten.