TERRITORY OF ALASKA, DEPARTMENT OF MINES,
JUNEAU, ALASKA.

MR Mt McKINLEY 66

COPPER MOUNTAIN AREA,

KANTISHNA RECORDING DISTRICT, ALASKA.

By

Earl R. Pilgrim

Feb. 7, 1930.

for U.S. Bureau of Mines
5/1942 - Ltr.

[illegible] DEPARTMENT [illegible]
[illegible] ALASKA.
Fairbanks Alaska
Feb.7 1930,

Mr. B. D. Stewart
Mining Department
Alaska, Territory,
Juneau, Alaska.

Dear Sir:

I herewith present a description of the Copper Mountain Area, Kantishna Recording District, Alaska. This area was first visited by me in 1923. In 1924 a detailed survey and examination was made of the claims owned by Thamas P. Aitken, Frank Jiles and O M. Grant. Short visits were made to this district in 1925, 1928 and 1929. Material for this report was obtained from these several visits and examination and from data obtained from other sources.

Location

The Copper Mountain Area is located in the foot hills of the Alaska Range in Mount Mc Kinley National Park immediately to the east of the foot of Muldrow Glacier and about 30 miles northeast of Mount Mc Kinley. The lode locations lie at elevations between 2800 feet and 4400 feet.

Transportation

This area is reached by aeroplane in summer or winter. A natural landing field is located in the smooth gravel basin at the foot of Muldrow Glacier and within ½ mile of the nearest locations. From the end of the Park Highway, now completed to the East Fork of the Toklat River, it is approximately 27 miles by trail. The Park Highway now completed 41 miles from Mc Kinley Park Station on the Alaska Railroad,will pass within ½ mile of the Copper Mountain Area. A railroad 70 miles in length could be constructed from Lignite Station to Copper Mountain without any unusual difficulties. There are two possible railroad routes to the Kantishna District. One would start near Kobe Station and follow along the north flank of the low range of mountains turning southwest after Chitsia Mountain was passed and after crossing the

Bearpaw, south of Diamond, would follow Moose Creek to Friday Creek.

From Friday Creek the road would follow up Moose Creek and turn southeast on the south branch to its head and turn down into the basin at Copper Mountain. The other route would start at Lignite and follow the series of low passes until the Toklat River was crossed. Then either Boundary or Clearwater Creeks would be followed to the head of Moose Creek and join the first route. The latter route is favored because it would intersect the Kantishna Hills and be closer to the present prospects such as the antimony deposite on Stampede Creek and the silver lead veins on Spruce Creek.

Timber Available For Mining

The nearest timber available to Copper Mountain is about 18 miles distant and located along the Mc Kinley Fork valley and north of the National Park Boundary. Sufficient spruce timber is available for all mining purposes and for rough saw timber.

Fuel

On Coal Creek a tributary of Stony Creek and about 5 miles north of Copper Mountain is a seam of lignite coal outcropping in several places. This seam has been opened up at one place and several tons of coal mined and hauled to Copper Mountain. This seam is said to be 30 feet in thickness. Because the cut had caved in I was unable to verify this thickness. An area 1 mile by 1½ miles covering this seam was applied for under a prospecting lease by J.J.Price, but no work has been done since 1923. A sample of this coal analyzed in the Pittsburg Station U.S.Bureau of Mines returned:

Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur
9.3	41.7	46.2	2.8	3.8

Calorific Value B.T.U. 11,680

Geology and Mineralization

This area has been subjected to recent glaciation, and bedrock surfaces are exposed in many places along the hillsides and ridges. The lower slopes are covered with a thick accumulation of slide rock which in places grades into glacial material along the benches. The moss and grass covering makes it difficult to distinguish glacial moraines from the low rounded recently glaciated hills.

The country rocks of this section are a paleozoic series of argillites, siliceous limestones and shales, intensively intruded by granitic dikes and sills. These sediments, ("Post Tonzona" Capps in " Toklat-Tonzona River Region" Bull. 792,1925) are much altered and deformed and in close proximity to the granites are highly silicified. ~~These sediments~~ trend slightly north of east and vary in dip from horizontal along Galena Creek to almost vertical along the East Fork of Mc Kinley River. The beds are so ~~badly~~ altered and cut by the intrusives that it is impossible to trace any particular bed over a short distance. In general the intrusives lie in a direction similar to that of the beds. They vary from N 24° E. to East, and dip steeply to the south. Several in the southern part of the area examined dip steeply to the north. They range in composition from granite to diorite, with granodiorite predominating.

The chief mineralization occurs in the sediments in and close to the contacts with the granite. These mineralized deposits vary in width from a foot to over a hundred feet and are found distributed generously along the contacts in an area ½ mile north and south by 4 miles in length, following a direction roughly corresponding to the direction of the dikes. In places the ore minerals have completely replaced the sediments. In other localities they are found confined to certain bedding planes, generally to those showing the higher lime content.

The ore minerals are sphalerite, galena and chalcopyrite with the gangue minerals, limestone, augite and quartz. The sphalerite predominates slightly over the galena. The chalcopyrite occurs only sparingly. The galena and galena-chalcopyrite carry the silver. Generally whenever the galena is found associated with the chalcopyrite, even in small amounts, there is a fair silver content. A general average of the silver and lead taken from many outcrops shows a ratio of 1 ounce of silver for each 3½ % of lead contained. The ores found on the Carrie and Virginia Claims show a higher silver content.

The mineralization farther to the east shows a greater proportion of zinc. On the Lead No.3 and Nord claims, the ratio is 1½% zinc to 1% lead. About a mile farther east on the Bald Claim there is an outcrop which samples 0.38 % lead and over 30 % zinc. This outcrop is about 500 feet higher in elevation than that on the Lead No. 3 Claim. On the Silver Line Claim at an elevation of 4,000 feet the lead predominates slightly over the zinc.

A number of fissures are found in this area cutting across the sediments. These veins are younger than the replacement deposits and carry as the principal ore minerals, chalcopyrite and bornite in a quartz gangue. These copper minerals contain considerable silver. They strike from N.76° W. to N.86° W. and stand vertical. They vary in width from a streak to 18 inches and average about 4 inches.

A compilation of assays from two of these veins on Galena Creek is given below:

Oz. Gold Per Ton.	Oz. Silver Per Ton.	Percent Copper.
0.07	36.80	
0.08	24.00	11.80
tr.	244.11	10.80
0.10	210.00	20.54

Oz. Gold per ton.	Oz. Silver per ton.	% Copper per ton.
0.10	86.50	
0.02	270.10	8.87
0.01	368.80	17.88
tr.	43.70	2.14
0.02	238.80	17.88
tr.	12.60	3.80
tr.	13.10	4.89

Very little work has been done on these veins because of their narrowness and irregular continuation.

A great number of the contact replacement zinc-lead ores outcrop and have been opened up by cuts. Many of these are noted on the map accompanying this report. Samples and assays from these outcrops are listed below.

Gold Oz.	Silver Oz.	Lead %.	Zinc %.	Copper %	Iron %.	
tr.	2.20	6.46	8.27	0.15	3.86	(sol) Composite sample from over 25 outcrops
0.01	3.80	7.43	11.88	Grab sample across width of 50 feet on Lead No. 3 Claim not average.		
				Width	Location	
0.01	2.5	8.19	11.09	25 feet	Tunnel Gulch Jiles Claim grab sample.	
0.01	1.6	5.28	6.83	20 feet	West of Tunnel Jiles Claim grab sample	
tr.	1.0	6.89	8.32	10 feet	Blacksmith Shop Cropping Jiles Claim grab sample.	
0.01	1.2	5.17	5.15	12 feet	Virginia Claim grab sample.	
tr.	0.9	8.62	8.91	11 feet	Tennessee Claim, Grab sample.	
0.10	7.87	5.0	13.00	2½feet	Denver Claim, channel sample	

The following assays are copied from Price and Aitken assayers' reports. Price and Aitken had an assay plant and assayer in 1922 when developing Grant and Jiles Claims.

Claim	Gold Oz.	Silver Oz.	Copper %.	Lead %.	Zinc %.
Jiles	tr.	2.75			17.20
"	0.10	7.75	tr.	12.50	23.62
"	0.10	6.00	tr.	20.00	20.99
"	tr.	3.50	tr.	22.00	32.72
"	0.12	7.65		40.00	18.70
"	tr.	2.20	0.38	6.35	9.03
"	tr.	1.40	0.45	8.70	9.22
"	tr.	1.30	0.10	18.80	31.10
"	tr.	1.50		22.70	26.15
"	tr.	2.10		16.30	23.68

K+66-34

On the Nord Claim there is an outcrop over 8 feet across which shows well mineralized ore all of the distance. The Lead K+66-29 No. 3 Claim has a mineralized width of over 100 feet measured along the river bank on the east end of the claim. On the Jiles 66-2 Claim a great amount of float is scattered along the hillside for several hundred feet. Some of this float is almost solid galena and sphalerite. Occasional pieces of this float are found weighing over 200 pounds.

A tunnel has been driven in for 100 feet at a point 300 feet from the west end of the Jiles Claim. K+66-2 This tunnel runs S 5° W. and is at an elevation of 3340 feet. A section of the tunnel measured from the mouth towards the face shows;

6 feet good ore behind lagging.

17 feet limestone with small bunches sphalerite, galena.

25 feet granite dike

26 feet limestone showing low grade mineralization.

24 feet granite.

A second tunnel 35 feet lower and about 40 feet east shows;

6 feet low grade ore.

20 feet rhyolite dike

19 feet low grade ore

18 feet granite.

A third tunnel 30 feet lower and 30 feet west driven in for 60 feet has not reached solid rock. An open cut a few feet east of the 100 foot tunnel at an elevation of 3380 feet shows a face of ore 25 feet across measured parallel to the strike of the formation. This ore will average low grade. Three cuts along the ridge 170 feet west of the 100 foot tunnel show strong mineralization. Two cuts, 330 feet west of the 100 foot tunnel on the west side of the gully, show strong mineralization with some good ore sorted and piled alongside. These cuts are about 30 feet long and are crosscutting the formation. On Galena Creek on the Virginia Claim, a tunnel has been driven in for 35 feet on a copper bearing fissure striking S 80° E. and standing vertical. No ore shows in the face.

There are many other cuts which show mineralization and outcrops are abundant but on the whole insufficient work has been done to prove either the presence or absence of valuable ore bodies. The location of the mineralization along and paralleling the north side of the mountain is ideal for prospecting with a diamond drill. Within the next two years, when the Park Highway approaches Copper Mountain, there will be a revival of diligent prospecting and development work.

Plenty of evidence is present in this area of an extensive mineralization which is worthy of further work. The low grade character of the ores and their low content of the precious metals will not permit their being worked, even if large deposits are found, without a railroad.

Locations

The following claims are now held in the Copper Mountain Area;

Mrs. Charles Stanford, Fort Gibbon, Alaska.

John Anderson, Wonder Lake, Mantishna, Alaska.

Nord	Alma	Altna
Brown Bear	Paula	Bald
Black Bear	Iron Ben	Humble

O. M. Grant, Fairbanks, Alaska.

Snow Drift	Kentucky	Jiles
Virginia	Carrie	
Denver	Tennessee	

Earl R. Pilgrim, Fairbanks, Alaska.

Galena No. 1	Silver Peak	Lead No. 3
Galena No. 2.	Lead No. 1	
Silver Mine	Lead No. 2	

These claims are all shown on map accompanying this report except for the seven claims belonging to John Anderson. They are on the mountain ½ mile directly east from the Nord Claim and across the East Fork of the Mc Kinley River. A number of other claims were staked in 1921 and 1922 and some work done on them but afterwards were permitted to lapse. Very little work other than annual assessment work has been done in this area since work was stopped by the Kennecott Copper Co. who had a number of claims under option and who drove the 100 foot tunnel on the Jiles Claim.

Concentration Tests Copper Mountain Ores.

A composite sample representing over 25 outcrops and weighing 1200 pounds was brought to the Alaska Agricultural College and School of Mines at Fairbanks and a considerable amount of work done in laboratory tests. Many of these tests showed poor results or indicated the wrong line of proceedure and are therefore not included in this paper. Much of this work here given was done by the writer, but credit is given forma good portion to Donald A. Morgan, who made soma origional flotation tests and to Paul Hopkins who performed all chemical analysis and assisted in the determination of unknown minerals.

A general analysis of this composite sample gave;

Lead	6.0%
Zinc	8.37 %
Copper	0.15 %
Soluble Iron	3.86 %
Total Iron	8.84 %
Lime (CaC)	17.62 %
Silica	29.96 %
Gold	Trace
Silver	2.2 oz. per ton.

Four picked pieces were sent to Harold Tomlinson, at Philadelphia, and thin sections made, one an average sample of the gangue rock adjoining the ore,,one an ore sample containing sphalerite,galena,and chalcopyrite, one an ore sample containing galena and sphalerite and one anore sample containing sphalerite alone. These thin sections,when examined under the microscope, showed;

1. The minerals were deposited in the ores contemporaneously.

2. Principal gangue minerals are augite,and silica.

3. That a fineness in grinding to pass a diameter of .0030 inch or equivalent to 200 mesh Tyler Standard is sufficient to free the sphalerite, galena, and chalcopyrite for concentration and that a good extraction should be possible when grinding to pass a diameter of .0040 inch or about 150 mesh Tyler Standard. An estimate made from microscopic examination and close inspection allows a possible extraction of 25% of the galena and 35 % of the sphalerite by table concentration. This of course refers to the general average of finely enclosed minerals. There is a portion of the ores which exhibits a coarseness of galena of which there could be no doubt about saving by table concentration.

Preferential Flotation Tests

Test No. 35

Janney Flotation Machine, first floating lead followed by zinc;

Reagents for Lead Froth.

1.5 gm. Soda Ash
0.4 " Sodium Cyanide
0.6 " Thiocarbanilide
589 " Ore

Ground 30 minutes in pebble mill with 1-1 pulp dilution, charged in machine with dilution 1-3 using G.N.S. No.5 Steam Distilled Pine Oil.

Reagents for Zinc Froth.

0.3 gm. Copper Sulphate
0.15 " T. T. Mixture
0.10 " G.N.S. No. 5

Product	Weight	Lead %	Zinc %	Total % of Metals Lead	Zinc
Heads	589 gm.	6.83	9.40	100	100
Lead Conct.	54 "	46.27	12.87	64.7	12.5
Zinc Conct.	70 "	9.62	45.34	16.7	57.4
Middlings	45 "	4.36	21.09	5.0	17.1
Tailings	420 "	1.1	1.73	13.6	12.9

Combining the Zinc Concentrate with the Middlings will give a product assaying 35.8 % Zinc and 7.56 % Lead and will show a recovery of 74.3 % Zinc. The middling product will instead be probably reground and returned to the flotation circut.

Test No 41.

Janney Flotation Machine , Lead Flotation followed by Zinc Flotation:

Reagents Lead Froth

1.5 gm. Soda Ash
0.1 " Sodium Cyanide
0.07 " Thiocarbanilide

Ground in Abbe Pebble Mill 30 minutes with pulp dilution of 1-1, charged to machine with pulp dilution of 1-3 using G.N.S.No.5 Steam Distilled Pine Oil. 0.10 gm.

Reagents Zinc Froth.

Tails from Lead Froth
0.3 gm. Copper Sulphate
0.15 " T. T Mixture
0.05 " G.N.S. No.5

Tails from Zinc Froth were concentrated on Overstrom Table and concentrates added to Zinc Concentrates.

Product	Weight	Lead %	Zinc %	Total % of Metals Lead	Zinc
Heads	573 gm.	6.51	8.32	100	100
Lead Conct.	50 "	46.57	14.85	60.8	
Zinc Conct.	68 "	7.76	46.33		66.0
Tailings	455 "	2.14	2.42	25.2	23.8

Test No. 43.

A sample was crushed to all pass a 50 mesh screen (Tyler) and concentrated on the Miniature Overstrom Concentrating Table to recover as much concentrates as possible and then the tailings were to be concentrated by flotation:

Product	Weight	Lead %	Zinc %	Gold Oz.	Silver Oz.	Total % of Metals Lead	Zinc	Silver
Heads	11,299 gm	5.11	9.11	Trace	2.60	100	100	100
Lead Conc.	350	72.68	5.74	0.08	21.20	39.7		25.2
Zinc Conc.	1,276	9.32	22.08					

Product	Weight	Lead %	Zinc %	Total % of Metals Lead	Zinc
Sand Tails	2,988 gm	2.70	8.32	7.4	11.3
Slime	6,650	3.61	5.84		

Test No. 43 A.

The Zinc Concentrate was reconcentrated to try for improvement in grade:

Product	Weight	Lead %	Zinc %
Zinc Conc.	350 gm.	13.86	30.99

Test No 45.

All products from above test,43 and 43 A, except Lead Concentrate were combined to form the heads for the following flotation tests using the Janney Flotation Machine;

Reagents Lead Froth.

1.5 gm. Soda Ash
0.03 " Sodium Cyanide
0.03 " Thiocarbanilide

Ground in Abbe Pebble Mill 30 minutes with pulp dilution 1-1. Charged to flotation cell with pulp dilution of 1-3 with G.N.S. No.5 Pine Oil Steam Distilled.

Reagents Zinc Froth.

Tails Lead Froth

0.2 gm. Copper Sulphate
0.01 " T. T. Mixture
G.N.S. No.5 Pine Oil

Products	Weights	Lead %	Zinc %	Gold Oz.	Silver Oz.	Total % Metals Lead	Zinc	Silver
Heads	516 gm.	3.60	7.92	Trace	2.00	100	100	100
Lead Conct.	50	32.96	13.07	0.06	13.10	78.0	16.3	63.5
Zinc Conct.	45	3.04	42.59			6.4	48.4	
Tailings	421	0.79	3.37			15.7	35.6	

By combining extractions and concentrates with Test No 43:

Product	Lead %	Zinc %	Gold Oz.	Silver Oz.	Total % of Metals Lead	Zinc	Silver.
Lead Conct.	50.46	9.71	0.07	16.2	86.67		72.69

At the same time we show a Zinc Concentrate of 42.89 % Zinc, 6.4 % lead and an extraction 47.37 % of the zinc.

The following tests were made by D. A. Lorgan using the same sample for his tests as were used in above tests:

Reagents and Conditions Lead Frothing.

Test No.	Na.Cn. gm.	ZnSO4. gm.	Thiocarbanilide	Na2CO3. gm.	Na2HPO4. gm.	G.M.S. No.5	Yarmor drops	Time Min.
1.	0.05		0.03	1.5		1.drop		15
2.	0.25	0.50	0.03	0.75		1. "		15
3.	0.05	0.50	0.03	0.75		1. "		15
4.	0.07	0.75	0.03	0.75		1. "		15
55.	0.05	0.25	0.06	0.75		1. "		15
6.	0.05	0.25	0.06	0.75		1. "		30
7.	0.05	0.08	0.06	0.75		1. "		35
9.			0.10		0.05	1.0"	1 drop	15

Reagents and Conditions Zinc Frothing

Test No.	CuSO4. gm.	CaCO3. gm.	G.M.S. No.5	Yarmor gm.	T-T Mix.	Time Min.	Mesh Tylor	Alkalinity
1.	0.2		1.drop		0.01	15	- 60	Al.
2.	0.5	0.75	1. "		0.03	20	- 60	Al.
3.	1.0	0.75	0.05		0.10	15	- 60	Al.
4.	1.0	0.75	0.05		0.10	20	- 60	Al.
5.	1.0	0.75	0.05		0.10	20	- 60	Al.
6.	1.0	0.75	0.05		0.10	20	-150	Al.
7.	1.0	0.75	0.05		0.10	20	-.60	Al. ###
9.	0.5			2 drop	0.10	15	- 60	Acid.

Used Miniature Callow Cell.

Results Lead Frothing

Test No.	Weight Heads	Products Made	Weight %	Lead %	Zinc %	Total Metals Lead	Total Metals Zinc.
1.	489	Lead Concentrate	15.6	58.77		27.73	
		Zinc Concentrate	52.6		37.-	44.7	44.7
2.	488	Lead Concentrate	13.7	64.24		25.73	
		Zinc Concentrate	29.1		33.3	21.9	21.9
3.	495	Lead Concentrate	31.51	57.85	7.16	60.4	5.38
		Zinc Concentrate	50.11	7.52	48.94	10.31	58.5
		Tailings		1.85	3.68		
4.	491.	Lead Concentrate	30.76	49.70	6.45	50.7	4.73
		Zinc Concentrate	69.23	10.69	37.94	24.3	62.7
		Tailings		1.92	3.49		
5.	573	Lead Concentrate	46.65	50.7	10.0	65.2	9.28
		Zinc Concentrate	75.05	7.08	47.48	14.64	70.91
		Tailings		1.61	2.2		
6.	593	Lead Concentrate	48.0	46.6	15.84	53.5	16.02
		Zinc Concentrate	31.2	9.01	42.37	17.45	72.7
		Tailings		2.63	1.15		
8.	976	Lead Concentrate	87.6	48.9	9.0	70.9	9.41
		Zinc Concentrate	96.4	5.7	44.5	9.09	51.2
		Tailings		1.53	4.16		
9.	491.	Lead Concentrate	44.8	39.9	22.0	59.25	23.5
		Zinc Concentrate	54.6	12.65	39.5	22.84	51.4
		Tailings		1.38	2.67		

The successful application of flotation to these ores is apparantly indicated by these tests even though they themselves do not show an economic recovery. A close examination of the ore used for these tests, shows much of the minarals are covered with a thin coating of zinc carbonate, derived from the oxidation of the smithsonite. Without doubt this oxidation extends only a few feet in depth and in actual operation little or none of the oxidized ores would be encountered.

A sample of ore was furnished the writer by John Anderson for testing. This sample was taken from the Bald Claim and is said to represent an average across a face of about 25 feet in width. This sample was taken across the face of a cut practically at the surface and when received showed much carbonate coating over the ore even when freshly broken. The zinc contained in the ore in the form of carbonate however would not average over 10 % of the total zinc. Analyses of this sample showed:

Gold	Trace
Silver	0.30 Oz. per ton
Lead	0.38 %
Zinc	30.19 %
Iron (Soluble)	5.54 %

Several flotation tests were made on this sample but it was impossible to make an economical concentrate. The use of sodium sulphide was not attempted as it was not deemed worth while in view of the fact that if actual mining was in progress the ores would not have this coating to interfere.

A concentration test made on a Miniature Overstrom concentrating table gave the following results:

Ore ground to - 30 mesh Tylor Standard Screen.

Product	Weight	Zinc %	Total Zinc Content %
Heads	7,250 gm.	29.51	100
Concentrate	2,899 "	48.11	65.12
Middlings	1,786 "	29.13	24.29
Tailings	2,572 "	10.39	10.59

The Middlings and Tailings products from above test were ground to pass an 80 mesh Tylor Standard Screen and tested for flotation. The best results obtained are given below.

Product	Weight	Zinc %	Total Zinc Content %
Heads	575 gm.	15.8	100
Concentrate	165 "	36.13	65.5

Tailings 410 gm. 7.62 % 34.5 %

A calculated total extraction by combining the last Concentrate with the previous one shows a total recovery of 87.97 % and a concentrate having an average assay of 44.9 % zinc. It is believed that a higher grade and higher extraction are possible especially if treating the unoxidized ore.

Respectfully Submitted

Feb. 7 1930, Earl R. Pilgrim