

*A. Shallit*

Annual Report  
OF THE  
**Mine Inspector**  
TO THE  
**Governor of Alaska**



1922

BY

B. D. STEWART, Mine Inspector

ACCOMPANIED BY SPECIAL ARTICLES BY JOHN A. DAVIS,  
SUPERINTENDENT OF THE FAIRBANKS EXPERIMENT STA-  
TION AND NORMAN L. WIMMLER, PLACER MINING EN-  
GINEER, U. S. BUREAU OF MINES.

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ANNUAL REPORT  
OF THE  
**MINE INSPECTOR**  
1922

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INTRODUCTION

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The following report contains a general review of mining conditions in Alaska in 1922 as well as detailed data as to individual operations in all branches of mining in nearly every district of the Territory.

Through cooperation with the Department of the Interior, Bureau of Mines, several papers prepared by members of the staff of the Bureau of Mines in Alaska are made a part of this report. These papers include articles on Lode Mining in the Fairbanks District, the Kantishna Region, and the Nenana Coal Field by Mr. John A. Davis, Superintendent of the Fairbanks Experiment Station, and one on Placer Mining in Alaska in 1922 by Mr. Norman L. Wimmeler, Placer Mining Engineer.

Acknowledgment is also to be made of the fact that, since the resignation of the Territorial Mine Inspector in July, 1922, the duties of his office, including the collection and preparation of much of the information contained in this report, has been cared for by the Supervising Mining Engineer for the Bureau of Mines, through the courtesy of the Department of the Interior.

Field examinations of mining properties and prospects were not as extensive in 1922 as was desired owing to the time necessarily devoted to other duties. It is planned to make such examinations and the preparation of reports from them a major feature of the work performed under the cooperative arrangement between the Territory and the Department of the Interior provided for by recent legislation enacted by the Territorial Legislature. By this means it is hoped to gradually build up in this office a record, available to the public, covering the essential data regarding as many as possible of the mining properties and prospects of Alaska. It is believed such data, based upon field examinations made by the staff of the Bureau of Mines in Alaska—such examinations to include whenever possible the taking of samples, which will be assayed at the Fairbanks Station—may be of much benefit alike to prospectors and prospective investors in Alaskan mining properties.

LETTER OF TRANSMITTAL

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Juneau, Alaska,  
May 26, 1923.

Hon. Scott C. Bone,  
Governor of Alaska.

Sir:

Herewith, in accordance with the provisions of Section 6, Chapter 51, Session Laws of Alaska for 1917, I have the honor to submit to you the annual report of the Mine Inspector covering the calendar year 1922.

Respectfully,  
B. D. STEWART,  
Mine Inspector.



## GENERAL STATEMENT

The feeling in Alaska with regard to the present situation in the mining industry is one of optimism.

### METALS

The year past was noteworthy for the extensive exploratory and preliminary development work undertaken and planned by large mining corporations in both lode and placer fields and in widely separated sections of the Territory.

The mineral production of the Territory was greater than in 1921 by about one and one-quarter million dollars.

Results of development work done on lode properties in many sections of Alaska during the past year have been very encouraging. Investors with financial strength have become interested in new properties in several regions, specifically the Hyder, Willow Creek and Kantishna districts. In several instances the properties acquired have had little or no preliminary underground work done upon them. Acquisition of the ground and a decision to carry out expensive programs of development have evidently been based largely upon reports of examining geologists as to surface showings and upon the favorable outlook for better transportation facilities.

That large mining corporations in the Territory are showing a willingness to assume the expense and risks of preliminary development upon unproven properties is proving a stimulus to renewed activity on the part of prospectors such as could be brought into being in no other way.

That the lode-gold production of the Territory has been maintained at a level but slightly below that of the previous year, in spite of the loss sustained by the closing of two of the largest low-grade gold mines in Southeastern Alaska, the Perseverance mine of the Alaska Gastineau Co. and the Ready Bullion mine of the Alaska United Co., is most encouraging. This favorable situation has been brought about by increased production from properties mining relatively high grade ores, notably in the Willow Creek district, by the milling of the output previously mined at the Nixon Fork property of the Alaska Treadwell Co., in the Kuskokwim district, and by the largely increased operations at the Alaska Juneau low-grade mine on Gastineau Channel.

By the skillful application of sound economic principles to the handling and reduction of the very low grade ores of the property and by improved mining methods worked out during the past year, together with rigid but intelligent economies practiced throughout its operations the management of the Alaska Juneau enterprise has scored a notable success. The progress being made by the Alaska Juneau Company toward the solution of the problem of successfully mining and reducing gold ores with an assay value of but \$1.00 per ton is an achievement of profound significance. The ultimate outcome of this enterprise, which has been

developed in the face of what appeared to be insuperable obstacles, will go far toward determining the future of the entire low grade gold belt of Southeastern Alaska.

In the field of placer mining pronounced features of the past year's activities were the expansion of the application of dredging methods to the recovery of alluvial gold; the success attending dredging operations, notably in the Innoko-Kuskokwim region; and the extensive exploration work undertaken on Seward Peninsula and in the Fairbanks region, with the purpose in view of determining the susceptibility of large areas of placer ground to the application of dredging methods.

### COAL

Production of coal in 1922 was 10½ per cent in excess of that in 1921. Private operators mined 90.2 per cent of the total output of 84,403 short tons. The remaining 9.8 per cent was produced by government operation on reserved units. The most pronounced new development of coal properties took place on Healy River in the Nenana field and along Moose Creek in the Matanuska field. The building of a railway spur from Healy to the coal beds at Suntrana, though not completed until October, 1922, enabled the Healy River Coal Corporation to mine and ship approximately 18,000 tons of coal from their Suntrana mine before the close of the year.

Surface development accomplished during the year along Moose Creek in the Matanuska field has served to reveal the outcrops of several coal seams whose existence was hitherto suspected but undemonstrated. These outcrops bear such relationships to one another as indicate a continuity of the seams along their strike much more pronounced than is characteristic of those portions of the Matanuska field heretofore explored. Sufficient work has not been done to determine the number of seams in the series exposed, their widths or mineability.

Near Mile 341 in the Broad Pass field a coal seam has been discovered, samples of which indicate that it is of bituminous grade. The seam, where exposed, is of mineable width and within a few hundred feet of the tracks of the Alaska Railway. Underground development work upon the bed has proceeded during the past winter.

### PETROLEUM

Field examinations of the prospective oil fields of the Alaska Peninsula, conducted during several years past, were followed by the commencement of actual drilling operations near the close of the year 1922. Three drilling rigs were placed on Pearl Creek dome in the West field of the Cold Bay district during the year, following the building of a 17-mile road from Kanatak to the drilling sites and the establishment at the latter places of permanent camps. Further surveys and field examinations were made in several other oil fields, including the Chignik, Iniskin Bay, Katalla and Yakataga districts.

Production of oil was confined to the Katalla field.

## REVIEW BY MINERALS

### COPPER

The value of the copper output of Alaska in 1922 exceeded that of gold by approximately \$1,800,000.

The tonnage of copper ore mined in 1922 exceeded that mined in 1921 by 104,160 tons, or 21.9 percent. From the total of 581,280 tons mined, approximately 67,000,000 lbs. of copper were recovered, having a value of about \$9,000,000.00. The corresponding value of the 1921 output is \$7,354,000.

The production in 1922 was made by the same mines that operated in 1921, namely the Kennecott group of the Kennecott Copper Corporation, in the Nizina district of the Copper River region; the Beatson mine of the same company on Latouche Island, in Prince William Sound; and the Rush & Brown mine on Prince of Wales Island.

With the exception of the work done on the Green group of copper claims in the Nizina district during the past two years, development of new copper properties in Alaska has been practically nil since 1918. The better prices and improved conditions prevailing in the copper market toward the close of the year have aroused renewed interest in copper-bearing ores and the coming year will probably be a season of activity in prospecting for such ores.

### GOLD

#### Lode-Gold.

Outstanding features of the situation in the lode-gold mining industry in 1922 are the increase in tonnage of low grade ores produced at the Alaska Juneau mine; the increased output from and the commencement of deep exploration on the lodes of the Willow Creek district; and the development in the Iditarod section of a gold lode that is reported to be one of much promise.

A revival of interest in the possibility of further successful gold lode mining in the Fairbanks district under improved transportation conditions has become evident.

One new stamp mill was put in operation during the year on Chichagof Island in Southeastern Alaska and two others are being assembled in preparation for operation during the coming year.

Prospecting work was fairly active during 1922, particularly in the Willow Creek district and elsewhere along the line of the Alaska Railway, and in the Iditarod section. Lode-gold prospecting on quite a large scale is reported to have taken place throughout the past winter in the latter district.

The production of gold from lodes in Alaska in 1922 is estimated to have a total value of \$3,600,000. (a) This amount is about \$200,000 less than the value of the output for 1921.

(a)—Mining in Alaska in 1922. Advance Statement by U. S. Geological Survey, January 1, 1923.

Two of the largest producing mines of the Territory, the Perseverance mine of the Alaska Gastineau Mining Co., and the Ready Bullion mine of the Alaska United Gold Mining Co., were permanently closed down during 1921 and 1922. That the large loss occasioned by these happenings has been made up within \$200,000 during one year by increased production from other properties is most encouraging and indicates a very healthy condition in the gold-lode industry as a whole.

#### Placer Gold.

The special paper on Placer Mining in Alaska in 1922, prepared by Mr. Norman L. Wimmeler, Placer Mining Engineer, U. S. Bureau of Mines, which is included in this report, furnishes a detailed survey of conditions in the Alaskan placer mining industry.

The following general statement as to placer production in 1922 is given by the U. S. Geological Survey. (a)

"About 560 Alaska placer mines, employing 1,900 men, were operated during the summer of 1922, and about 100, employing 300 men, during the previous winter. These mines produced gold to the value of \$4,100,000. In 1922 a much larger number of men—about 600—were employed than have been employed for several years in the past in installing large mining plants that are as yet unproductive. For this reason the estimated reduction of \$125,000 in the value of placer gold output in 1922 as compared with 1921 is not significant. It is certain that when the plants now being installed are operated the output of placer gold will be increased; it will be larger in 1923 than it was in 1922. Now that the means of transportation are improving and it is becoming recognized that there are large areas of dredging ground in Alaska, this form of mining is being more widely extended. In the summer of 1922, after two years of systematic prospecting, two dredges, the largest in Alaska, were built at Nome, with 9-cubic foot buckets and 40 and 60-foot ladders. A strong company was also engaged in extensive prospecting of dredging ground in the Fairbanks district. During the summer a dredge was being taken to Gaines Creek, in the Innoko district, and another to Minook Creek, in the Rampart district, so that four new gold dredges will be installed in Alaska in 1923. In 1922, 23 dredges produced gold worth about \$1,530,000; in 1921, 24 dredges produced gold worth \$1,582,520. Of the 23 dredges operated in 1922, 16 were in Seward Peninsula; 2 each in the Iditarod and Fairbanks districts; one each in the Innoko, Mount McKinley (Upper Kuskokwim), and Yentna (Susitna) districts. The dredges in Seward Peninsula produced about \$650,000 worth of gold in 1922."

### SILVER-LEAD

Marked activity in the Hyder district and the acquisition by the Kennecott interests of large holdings in the newly discovered silver-lead area

(a)—Mining in Alaska in 1922. Advance Statement by U. S. Geological Survey, January 1, 1923.

in the Copper Mountain section of the Kantishna region have attracted particular attention to the possibilities connected with silver-lead mining in the Territory.

An effort will be made during the coming season to prospect the silver-lead bearing area known to exist at the headwaters of the Unuk River bordering Southeastern Alaska. This area lies east of Ketchikan and is in the northward extension of the "eastern contact belt" within which the ore bodies of the Portland Canal section occur.

While the mineralized area is in British Columbia, the only feasible route by which it may be reached is through the Unuk River Valley, which lies almost wholly in Alaska. The region is therefore directly tributary to Ketchikan.

A small silver-lead property situated in the Kaiyuh Mountains southwest of Ruby made a small production during the year. This property is described elsewhere in this report.

A small shipment of high grade silver-lead ore was made by Mr. Hawley Sterling from the Red Top lode in the Kantishna district upon which he holds a lease. This ore was mined during the winter and transported to Kobe on the Alaska Railway by dog team and was shipped from there to the smelter at Tacoma.

The existing freight rate from Kobe to Tacoma on silver-lead ore having a value of \$50 per ton or less is \$12.25 per ton.

The total output of silver in Alaska in 1922 is estimated at 730,000 oz (a)

That for 1921 was 761,085 oz.

## COAL

The production of coal in the Territory in 1922 amounted to 84,403 tons. This tonnage exceeds that of the previous year by 8,118 tons and is to that extent the largest output for any one year since coal mining began.

Private operators produced 90.2% of the total output in 1922 as compared with 30.8% in 1921.

An underground fire in the Evan Jones mine that occurred in November, 1922, compelled the Alaskan Engineering Commission to re-open the Eska mine in order to insure an adequate supply of coal to the railway during the winter. Otherwise the percentage of coal mined by private operators would have been even higher than above indicated.

The most important event of the year affecting coal mining was the completion in October of the railway spur from Healy, on the Alaska Railway, to the coal beds at Suntrana, in the valley of the Healy Fork of the Nenana River. The coal beds made available to cheap transportation by this 4-mile spur line are destined to play an important part in the economic development of the entire interior of Alaska. The coastal

(a)—Mining in Alaska in 1922. Advance Statement by U. S. Geological Survey, January 1, 1923.

sections of the Territory will also be benefited, directly or indirectly, by the existence of this very extensive supply of cheap fuel.

The coal beds at Suntrana have been described and the present situation discussed by Prof. Patty of the Alaskan Agricultural College and School of Mines. (a)

A detailed description of coal mining in the Nenana field, accompanied by analyses of the coals, by Jno. A. Davis, of the U. S. Bureau of Mines, forms a part of this report.

The Matanuska field supplied 64 percent of all coal mined in Alaska in 1922. This percentage amounted to 53,658 tons.

Surface development work conducted during the past year in the Moose Creek section of the Matanuska field resulted in exposing the surface outcrops of a series of coal seams that may prove to be important.

Another discovery made during the year which may prove important was that of a bed of coal of bituminous grade adjacent to the Alaska Railway, near Mile 341, in the Broad Pass section. Open cut exposures indicate this seam to be of mineable width.

Very little mining was done in the Cook Inlet lignite field. The total production from that field was 2,729 tons.

Production in the Bering River field was confined to the mining of a sample of coal for use in making a Navy test.

## PETROLEUM

The occurrence of petroleum seepages and the existence of other conditions indicating the presence of oil at many places along the southerly coast of Alaska have been known for many years.

As early as 1882 petroleum was secured at Oil Bay on the west side of Cook Inlet from seepages that had been known to the Russians for many years prior to that time. (a). The region indicated is now known as the Iniskin Bay field. Some drilling was done at Oil Bay in 1898 and at Dry Bay in 1902. Operations continued until 1904. Oil was struck and gas under pressure was encountered but drilling difficulties compelled the abandonment of the wells and work was not afterward continued.

In the Controllor Bay field, now known as the Katalla field, drilling was commenced in 1901. Several additional wells were drilled during 1903 and by September, 1904, "fifteen wells had been drilled or were drilling in this region."

Although no drilling has been done in the Yakataga field, formerly referred to as the Yaktag region, seepages were known and surface explorations had been made prior to 1903.

(a) Patty, Ernest N.—The Healy River Coal Deposits, Farthest North Collegian (issued by the students and faculty of The Alaskan Agricultural College and School of Mines, Fairbanks, Alaska), Vol. 1., No. 1.

(a)—The above information and the following data on the history of drilling, etc., were secured from articles by Martin, G. C.—Petroleum Fields of Alaska, U. S. Geological Survey Bulletin 225, p. 379, and U. S. Geological Survey Bulletin 250.

Though the existence of seepages in the vicinity of Cold Bay was known to the early Russian occupants of Alaska, the presence of petroleum was recorded in print in 1869, wells were first drilled in the Cold Bay district of the Alaska Peninsula in 1903. Three wells were sunk during that year, one of which reached a depth of 1500 feet. Writing in 1905, Martin says: (a)

"They are located about 5 miles from the landing on the west shore of Cold Bay, at an elevation of about 750 feet above tide, and are distant about 9 miles in an air line from Becharof Lake."

They were thus in the east field and approximately 20 miles distant from the site of the present drilling operations in the Pearl Creek section of the west field.

With the exception of the productive operations in the Katalia field, which still continue, no underground exploration for petroleum has been conducted in Alaska since the cessation of the activities above noted.

In 1910 all unpatented oil lands in Alaska were withdrawn from entry. They so remained until the passage by Congress of the oil leasing act of 1920. Since that time there has been great activity in staking oil claims and in field examination in all the petroleum fields of Alaska. This activity culminated in the commencement of drilling operations on the Pearl Creek dome in the west field of the Cold Bay district shortly after the close of the year 1922.

During the month of August, 1922, two drilling rigs of the cable type were shipped to the Cold Bay field by the Associated Oil Company and one by the Standard Oil Company of California. These shipments were discharged at Kanatak, a small Indian village at the head of Portage Bay. All the material had to be lightered from ship to shore and during the landing operations there were many days when no cargo could be discharged on account of rough weather prevailing. From 14 to 17 days were required to land these shipments on the beach.

From Kanatak to the drilling sites, at Pearl Creek dome, the distance is 17 miles. After landing the equipment at Kanatak the working crews had to construct the road over which to haul the freight. This road was completed during October and the erection of camps was begun at the drilling sites.

Motor tractors were used as means of locomotion in hauling the freight. Considerable difficulty was experienced in the freighting operations, due principally to the steep gradients on the road in reaching the first summit out of Kanatak and to stormy weather. All obstacles were successfully overcome, however; permanent camps were constructed, the rigs were erected and drilling operations are in progress at the present time.

(a)—Martin, G. C.—The Petroleum Fields of the Pacific Coast of Alaska, U. S. Geological Survey Bulletin No. 250, p. 55.

## TRANSPORTATION, AS AFFECTING THE MINING INDUSTRY

Lack of adequate transportation facilities still remains a serious handicap to the development of the mining industry in Alaska, although some progress has been made during the past year toward improving the situation. Better shipping facilities have been given the Hyder district and the steamer service to Southwestern Alaska has been slightly improved.

With the completion of the Tanana River bridge on the Alaska Railway during the past winter the final stage has been reached in the construction of the government railway to Fairbanks.

The inauguration by the Department of the Interior of regular steamer service between Nenana and Holy Cross will be a great boon to mining operators in all camps tributary to the lower Yukon.

The Alaska Road Commission and also the Forest Service, acting through the U. S. Bureau of Public Roads, have done much during the past year to improve the conditions of roads and trails in many mining regions, but funds have been entirely inadequate to meet the urgent need for new construction that exists in nearly every district in the Territory.

Comments on transportation conditions in various regions and their effect upon mining operations will be found in this report in connection with the detailed review of the several mining districts.

## PROSPECTING AND MINING WITHIN NATIONAL FOREST AREAS

The intent of Congress in regard to mineral rights of prospectors within National Forests is expressed in the following words in the Act of June 4, 1897, which authorizes administration of those areas:

"Nor shall anything herein prohibit any person from entering upon such forest reservation for all proper and lawful purposes, including that of prospecting, locating, and developing the mineral resources thereof: Provided that such persons comply with the rules and regulations covering such forest reservations."

In short the general mining laws of the United States, so far as they apply to any part of Alaska, apply equally within as outside National Forest areas. Prospectors may enter National Forests without restriction to prospect, locate and develop mining claims upon any unoccupied land.

Not only may they cut and use without restriction, charge or permit as much of the timber from their claims as is necessary for development work on them, but in addition a special regulation of the Secretary of Agriculture permits any bona-fide prospector or settler to take timber from land outside of their claims for their own personal use but not for sale. The amount of such timber shall not exceed 10,000 feet board measure and 25 cords of wood in any one year. No permit is required except for green sawtimber.

Prospectors are, of course, expected to take every precaution to prevent forest fires in regions where there is fire danger.

When application for patent to a mining claim within a National Forest is made, the Land Office requests a statement from the Forest Service as to whether or not legal requirements for the issuance of patent have been complied with.

### LABOR CONDITIONS

Experienced metal miners have been difficult to secure during 1922. Other labor was obtainable without difficulty.

Wage scales have been changed but slightly during the year. Where changes have taken place the trend has been upward. In only isolated and unimportant instances have reductions been made.

During 1922 the wage scale at the larger lode mines of the coastal region ranged as follows:

FOR AN EIGHT HOUR SHIFT	FROM	TO
Machine drillmen .....	\$4.60	\$5.50
Machine helpers .....	4.00	5.00
Muckers .....	4.10	5.00
Timber men .....	5.00	6.00
Timber men's helpers .....	4.10	4.75
Trackmen .....	4.50	5.25
Pipemen .....	5.00	5.50
Carpenters .....	5.50	7.00
Carpenters' helpers .....	4.00	5.00
Blacksmiths .....	5.75	7.00
Blacksmiths' helpers .....	4.00	5.50
Hoisting engineers .....	4.00	5.75
Cagers .....	4.35	5.25
Laborers .....	3.50	5.00

From the above wages deductions are made for board and room and for hospital fees and medical attendance. Deductions for board range from \$1.00 to \$1.50 per day, and for hospital and medical attendance from \$1.50 to \$2.40 per month.

Living costs in the coastal sections of Alaska are slightly higher than in the States of the Pacific Coast.

Wage and living conditions in interior Alaska are difficult to state in general terms owing to the wide fluctuation between localities. In the larger camps, such as Fairbanks and Iditarod, wages for placer miners are from \$5 to \$6 per day, in addition to which the operators furnish board. The item of board is estimated at from \$2 to \$3 per day. In more remote regions wages of from \$7 to \$10 per day and board are received.

The total wages distributed in the Alaska mining industry during 1922 are estimated to amount to approximately \$4,740,000.00. The pay rolls included in this total are distributed as follows:

Placer mines (estimated on the basis of 2,200 men, employed for an average of 150 days) .....	\$1,650,000
Gold-lode mines and mills .....	1,280,000
Copper mines and mills .....	1,281,000
Non-metal mines and quarries .....	129,000
Coal mines (estimated from number shifts worked) .....	400,000

TOTAL .....

There were about 4,000 men employed in all branches of the Alaskan mining industry during 1922, which is the same as the estimate for 1921. That this number has been maintained indicates that the general increase in the number of men employed throughout the Territory during the year

was sufficient to offset the loss occasioned by the closing of the large low-grade gold mine of the Alaska Gastineau Mining Company in South-eastern Alaska, where an average of 450 men were employed.

Details as to the number of men employed and shifts worked in the various branches of lode mining will be found appended to the accident tables herein.

### COST OF A "GRUBSTAKE"

Retail price-list of groceries, in amounts estimated to be such as would constitute a season's "grubstake" for a prospector, furnished by representative retail grocers at Juneau and Fairbanks:

Quantity	Article	Juneau Prices	Fairbanks Prices
10 lbs.	Apples, dried .....	\$ 2.00	\$ 3.00
1 box	Apples, fresh .....	3.50	6.00
10 lbs.	Apricots, dried .....	4.00	4.00
50 lbs.	Bacon .....	22.50	27.50
10 lbs.	Beans, lima .....	1.25	1.75
15 lbs.	Beans, navy .....	1.80	2.25
1 doz.	Beef, corned, 2 lb. cans .....	5.50	5.50
80 lbs.	Fresh beef .....	12.80	24.00
1 doz.	Beef, roast, 2 lb. cans .....	5.50	5.50
48 lbs.	Butter, canned or salt pckd. ....	26.40	28.80
1 box	Candles .....	3.25	4.50
6 bots.	Catsup .....	2.25	2.75
10 lbs.	Cheese .....	3.80	4.50
40 lbs.	Coffee .....	16.00	18.00
1 cs.	Corn, canned .....	5.50	5.50
1 cs.	Eggs .....	11.25	18.50
100 lbs.	Flour, graham .....	5.25	8.00
200 lbs.	Flour, white .....	10.60	16.50
50 lbs.	Ham .....	17.50	25.00
10 gal.	Kerosene .....	3.50	7.00
20 lbs.	Lard .....	4.25	5.00
1/2 cs.	Loganberries, canned .....	3.65	4.50
10 lbs.	Macaroni .....	1.50	1.25
1 doz.	Matches, caddies .....	1.00	1.75
50 lbs.	Meal, corn .....	2.50	4.00
4 cs.	Milk, canned .....	22.00	28.00
1 gal.	Molasses .....	.90	1.75
50 lbs.	Oats, rolled .....	3.00	4.50
25 lbs.	Onion, dried .....	1.50	2.00
1 cs.	Oranges, fresh .....	7.00	16.50
1/2 cs.	Peaches, canned .....	4.25	5.25
10 lbs.	Peaches, dried .....	3.00	3.25
1/2 cs.	Pears, canned .....	4.75	5.25
1 cs.	Peas, canned .....	7.00	5.50
1/2 cs.	Pineapple, canned .....	4.25	5.25
15 lbs.	Pork, salt .....	4.50	3.75
200 lbs.	Potatoes, fresh .....	5.50	15.00
5 lbs.	Powder, baking .....	2.25	3.00
10 lbs.	Prunes, dried .....	2.00	2.50
10 lbs.	Raisins, bulk .....	2.00	3.00
20 lbs.	Rice .....	2.00	2.50
1 doz.	Salmon, 1 lb. cans .....	4.25	4.50
5 lbs.	Salt .....	.20	.35
2 bots.	Sauce, L. & P. ....	.70	1.50
2 doz.	Soap, Ivory .....	2.40	5.00
2 pkgs.	Soda, baking .....	.25	.60
1 lot	Spices, assorted .....	.15	1.00
1/2 cs.	Strawberries, canned .....	4.25	5.25
50 lbs.	Sugar, granulated .....	6.00	5.50
1 cs.	Syrup, Log Cabin .....	12.50	14.00
5 lbs.	Tea .....	4.50	4.50
1 cs.	Tomatoes, canned .....	5.50	6.00
1 bot.	Vinegar, concentrated .....	.25	1.25

Totals .....

\$293.90 391.50

1156 lbs. excluding items for which

## ASSISTANCE TO THE ALASKA MINING INDUSTRY BY THE DEPARTMENT OF THE INTERIOR

In response to memorials submitted to Congress by the Territorial Legislature during its sessions of 1919 and 1921, provision has been made by the Department of the Interior to enlarge the scope of the service activities of its Bureau of Mines in Alaska.

This has been accomplished by the reorganization of the staff in the Territory whereby the work of the mining experiment station and Federal mine inspection service are consolidated and a first-aid and mine rescue service is established.

### Bureau of Mines.

The work of the Bureau of Mines in Alaska, as at present organized, is conducted under two main divisions, namely:

- (a) Field investigations and Service Work.
- (b) Experiment Station Work.

The duties falling under these two divisions are allotted as follows:

Executive control over both divisions is vested in the Supervising Engineer who is also ex-officio Federal mine inspector and authorized representative of the Secretary of the Interior in the matter of coal, oil and gas leases and permits.

Field investigations and service work to miners, operators and prospectors are allotted to a placer mining engineer, a coal mining engineer, a special coal mining engineer and geologist, and a first-aid miner. Provision has also been made for the appointment of a coal sampler and analyst and also for a special petroleum engineer, when his services are required.

Lode mining investigations and service work to lode miners and prospectors are cared for by the Supervising Engineer with the assistance of other members of the staff.

A clerk is stationed at the Anchorage field office, which is the headquarters office for Alaska.

The work of the Experiment Station at Fairbanks embraces the assaying of ores and the quantitative and qualitative determination of mineral substances; the conduct of a reading room and reference library covering subjects related to mining and metallurgy; the analysis and utilization of coals; and the handling of all metallurgical problems that may be brought before the Bureau in Alaska for solution.

The staff of the Experiment Station consists of a Superintendent, who has direct supervision over all the work of the station; an analytical chemist and mineralogist; a mechanic, who cares for the mechanical equipment of the station and assists in making milling tests, etc.; and a clerk.

The station is equipped with complete laboratory facilities necessary for making tests of ores, etc. This equipment is available to the students of the Alaska Agricultural College and School of Mines.

Any special problems or investigations which, owing to lack of equipment or personnel, cannot be handled at the Fairbanks Station are as-

signed, through the Supervisor of Stations, to one of the many Bureau of Mines experiment stations in the States.

Identification of mineral substances, as distinguished from assaying and quantitative determination, is done for the public free of charge. A nominal fee, just sufficient to cover cost of materials used, is charged for assays and quantitative determinations.

Since July 1, 1922, the duties assigned to the Office of Territorial Mine Inspector have been cared for by the staff of the U. S. Bureau of Mines. Under this arrangement the expense of administering the act relating to the inspection of mines has been materially reduced and has resulted in an unexpended balance of \$6,830.70 in the appropriation for the Office of Territorial Mine Inspector for the biennium 1921-1923. This sum reverted to the Treasury of the Territory March 31, 1923.

### First Aid and Mine Rescue Service.

Of the new activities instituted during the past biennium by the Department of the Interior for the purpose of assisting the mining industry of the Territory, one of the most important is the inauguration of a permanent first-aid and mine rescue service.

A trained first-aid miner has been assigned to duty in Alaska, with headquarters at Anchorage. His duties consist of visiting all mining camps for the purpose of giving training in first-aid to injured persons. Where conditions warrant it, training is also given in mine rescue and recovery work.

First-aid work is particularly important in Alaska, where many small mining camps are situated in isolated localities, remote from hospital and medical service. First-aid work is being extended to these camps as well as to the larger mining communities, and prospectors and miners are being taught the proper care to be given injured persons.

During 1922 approximately 275 persons in Alaska received this training.

Mine rescue and recovery work, which includes the use of oxygen-breathing apparatus, was taught to crews at the coal mines and at the larger metal mines.

The value of this work was demonstrated upon the occasion of the coal mine fire which occurred at the Evan Jones Mine in the Matanuska field in November, 1922. As soon as possible after this fire was reported a crew was assembled and trained in the use of oxygen-breathing apparatus. The work of this crew, trained by the first-aid miner, enabled the mine to be explored in the presence of noxious gases generated by the fire and resulted in ventilation being restored and the recovery of the mine to be effected promptly after the fire was extinguished.

Through the cooperation of the Alaskan Engineering Commission plans have been perfected for equipping a mine rescue car for use along the line of the Alaska Railway. This car will be furnished with ten sets of oxygen-breathing apparatus and other equipment necessary to effectively meet such emergencies as mine fires or other disasters.



The following table indicates the extent of the training given by the first-aid miner from July 1st to December 31st, 1922:

RECORD OF FIRST AID AND MINE RESCUE TRAINING,  
JULY 1, 1922 to DEC. 31, 1922.

District	Place	Qualified Certificates		Additional Training		Partial Training	
		First Mine Aid Rescue	Total	First Mine Aid Rescue	Total	First Mine Aid Rescue	Total
Willow Creek	Gold Bullion .....	12	0	12	0	0	0
Willow Creek	Lucky Shot .....	10	0	10	0	0	0
Willow Creek	Gold Mint .....	6	0	6	0	0	0
Willow Creek	Mountain Home..	1	0	1	0	0	0
Kantishna	Copper Mtn. ....	0	0	0	0	0	0
Kantishna	Wonder Lake.....	0	0	0	0	0	0
Kantishna	Friday Creek .....	0	0	0	0	0	0
Kantishna	Eureka Creek .....	0	0	0	0	0	0
Fairbanks	Students A.A.C.&S. Mines .....	8	0	8	0	0	0
Fairbanks	Short Course .....	3	0	3	0	0	0
Fairbanks	Fire Men .....	6	0	6	0	0	0
Matanuska	Jonesville .....	6	5	11	3	0	0
TOTALS .....		52	5	57	3	0	0

At Fairbanks 12 Boy Scouts and their Scout Master completed the regular course.

Summary—First Aid

Qualified for Certificates .....	52
Additional training .....	3
Partial training .....	60
	115
Boy Scouts .....	12
Total .....	127

Summary—Mine Rescue

Qualified .....	5
Partial training .....	31
Total .....	36

## U. S. GEOLOGICAL SURVEY

The work of the U. S. Geological Survey in Alaska was continued in 1922, as formerly, under the direction of Dr. Alfred H. Brooks.

Topographic surveys and geologic studies were made on the Alaska Peninsula over areas of interest primarily on account of their relation to petroleum deposits. Similar work was conducted along the West shore of Cook Inlet.

Other parties in the field investigated mineral resources in areas adjacent to the Alaska Railway, in the Yukon and Tanana basins, and in the Wrangell district in Southeastern Alaska.

During the coming season reconnaissance surveys will be made southward from Cook Inlet and northward from Cold Bay, both terminating at Katmai Park. Special geologic investigations will be made at Cold Bay and Chignik.

Investigation of the mineral resources in the Alaska Railroad region will be continued and additional studies will be made of the copper deposits in Prince William Sound. The mineral resources of the Chandalar region, north of the Yukon, will be studied, and in Southeastern Alaska geologic work will be carried on in the area lying between Wrangell and Juneau.

## ALASKA AGRICULTURAL COLLEGE AND SCHOOL OF MINES

The Alaska Agricultural College and School of Mines at Fairbanks was opened to students in the fall of 1922. The establishment of this institution in the Interior of Alaska has attracted wide attention.

Four-year courses in Civil Engineering and Mining Engineering are offered. Short courses in mining and mineralogy, designed primarily to meet the practical needs of prospectors and miners, are also being given. These short courses are proving popular and have been well attended.

The following information with regard to the location of the college and the expenses attached to attendance thereat is given in a bulletin issued by the college authorities:

### LOCATION

"The site of the College is about four and one-half miles from Fairbanks on an elevation which commands a magnificent view of the Tanana Valley and the main Alaska Mountain Range. The College is easily reached either by train on the Government Railroad which passes at the foot of the Campus, or by automobile on the road from Fairbanks to Ester Creek.

"On the four sections of land granted to the Territory as a site for the College is located the Government Experiment Station of the Department of Agriculture. At Fairbanks is located the Alaska Experiment Station of the United States Bureau of Mines.

"The natural advantages afforded the student of agriculture or of mining by virtue of selecting a site for the College in the Tanana Valley are of the greatest importance. This is the center of Alaska's agricultural activities. Within easy reach practically every known method of gold placer mining can be found in actual operation. Locally, quartz mining is developing. The Healy River and Matanuska coal fields can be reached by train, and both the Government Railroad and the Richardson Highway are available to reach quickly and easily the mining operations being carried on at Kennecott and in the Prince William Sound section.

### TUITION

"Tuition in the College is free to both residents and non-residents of the Territory during the year 1922-23.

"Laboratory charges sufficient only to cover the cost of the material consumed will be assessed each semester.

"Text-books and stationery supplies can be purchased at the College.

### EXPENSES

"The College is not prepared to furnish room and board for its students during this first year of its existence. It is hoped that by another year the institution will be equipped with a suitable dormitory and facilities for boarding those students who desire such service.

"Suitable rooms can be secured in the town of Fairbanks at a cost of from \$15.00 to \$25.00 per month. Board can be obtained at a cost of from \$1.50 to \$2.00 per day. These expenses can be reduced somewhat by

one who desires to rent a cabin and provide for himself. It is suggested that clubs can be organized and excellent room and board obtained in that way at a reasonable cost."

The faculty of the College is as follows:

CHARLES E. BUNNELL

Bucknell '00, A. B.; Bucknell, '02, A. M.  
President.

CLINTON H. MORGAN

Kansas State Agricultural College, '22, B. S.; Kansas State Agricultural College, '22, M. S.  
Professor of Agriculture and Instructor in Military Science.

ELIZABETH E. KIRKPATRICK

Kansas State Agricultural College, '20, B. S.; Kansas State Agricultural College, '22, M. S.  
Professor of Home Economics and English.

HERBERT D. BRUCE

University of Nevada, '20, B. S.; Lafayette, '22, M. S.  
Professor of Chemistry and Physics.

ARCHIE M. TRUESDELL

University of Washington, '15, B. S.  
Professor of Mathematics and Civil Engineering.

ERNEST N. PATTY

University of Washington, '19, B. S.  
Professor of Geology and Mineralogy.

EARL R. PILGRIM

University of Washington, '16, B. S.  
Professor of Mining Engineering and Metallurgy.

## PLACER MINING IN ALASKA IN 1922

By

NORMAN L. WIMMLER

Placer Mining Engineer, U. S. Bureau of Mines.

### Introduction.

This report is intended to give early publication to a review of placer mining operations and developments in Alaska during 1922, as well as touching briefly on economic features affecting the industry. In conducting field work during the past season, the writer visited Seward Peninsula and the Ruby, Hot Springs, Rampart and Fairbanks districts. Information on other districts has been obtained from many sources, but it is regretted that at the time of the preparation of this report more detailed data were not available.

The writer wishes to extend his thanks to the many Alaskans who have so kindly assisted him with information and for the many courtesies shown him in the field. The work of the U. S. Geological Survey has been liberally consulted and used in this report, for which special acknowledgment is made.

### Production.

The Alaska placer mines in 1922, according to estimates based on early returns, produced gold to the value of \$4,100,000 (1) or about 23% of the total value of the mineral production for that year. Final returns should increase this amount from \$100,000 to \$200,000. While this advance estimate of the output indicates a small decrease from the preceding year, it does not signify that a proportional lack of interest is being taken in the industry, for new plants are being installed which will be productive during the coming season.

In 1922, according to the U. S. Geological Survey, about 560 Alaska placer mines, employing 1900 men, operated during the summer and about 100 employing 300 men, during the previous winter. About 600 men were employed during the year installing large placer mining plants, which are as yet unproductive. This is a much larger number than has been employed in similar work for several years. Among the reported number of operations are many small mines which were operated for only a short time during the year and which produced but a few hundred dollars each.

The annual production of gold from dredges has increased in value from \$20,000 in 1903 to \$2,200,000 in 1913. Dredge building had been carried on very actively before the War. In spite of adverse conditions, the dredges that had been constructed continued to increase their output. This did not reach its maximum until 1916, when its value was \$2,679,000. The output of gold from dredges thereafter steadily declined until in 1920 its value was \$1,130,000. (1)

(1)—Mining in Alaska in 1922. Advance Statement, U. S. Geological Survey.

(1)—Mining in Alaska in 1922. Advance Statement, U. S. Geological Survey.



TABLE NO. 1.—DATA ON GOLD

Name	Location	Type	Size bucket Cu. ft. Bucket line	No buckets per min.	H.P.
SEWARD PENINSULA					
1(d) Alaska-Kougarok	Taylor Cr.	Stacker	2½ open	15	70
2(d) Alaska Mines Co.	Wonder Cr.	Stacker	8 open	....	330
3(a) Arctic Cr. Dredge	Arctic Cr.	Flume	2½ open	....	60
4(a) Bangor Dredging	Anvil Cr.	Stacker	3½ close	....	140
5(a) Behring Dredging	Kougarok R.	(g)	2½ close	24	100
6(d) Candle Cr. Dredge	Candle Cr.	Flume	1¾ close	16	50
7(a) Center Cr. Dredge	Snake R.	Stacker	3½ close	26	112
8(c) Casadepaga Dredge	Canyon Cr.	Flume	2½ open	....	60
9(a) Crooked Cr. Dredge	Crooked	Flume	2½ open	16	65
10(a) Dexter Cr. Dredge	Dexter Cr.	Stacker	2¾ open	12	85
11(d) Dobson Dredge	Burk Cr.	Stacker	2¾ open	....	100
12(a) Eskimo Gold Mg. Co. (i)	Solomon R.	Stacker(f)	5 close	21	200
13(d) Fries Dredge	Inmachuk R.	Flume	2¾ open	....	50
14(a) G. & O. Dredge	Warm Cr.	Flume	1¾ open	18	20
15(a) Glacier Cr. Dredge	Glacier Cr.	(g)	2½ open	15	60
16(b) Hammon Cons. Ggfs.	No. 53 Little	Stacker	9 close	....	592
17(b) Hammon Cons. Ggfs.	No. 54 Little	Stacker	9 close	....	592
18(d) Inmachuk Dredge	Inmachuk R.	Flume	3 open	....	100
19(a) Iversen-Johnson	Big Hurrah	Flume	1¾ open	18	20
20(a) Julian Dredge	Osborne Cr.	Stacker	2¾ open	14	80
21(c) Kugruk Dredge	Keewalik R.	Flume	3½ close	22	100
22(a) Northern Light	Ophir Cr.	Flume	2½ open	16	70
23(a) Shovel Cr. Dredge	Shovel Cr.	Flume	2½ close	19	70
24(d) Swanson Cr. Dredge	Swanson	Flume	2 open	....	....
25(a) Wild Goose No. 1	Ophir Cr.	Stacker	3½ close	17-33	140
26(a) Wild Goose No. 2(j)	Ophir Cr.	Stacker(f)	3 close	21	100
27(d) Uplit Dredge	Camp Cr.	Flume	2 open	....	60

## CACHE CREEK DISTRICT

28(a) Cache Cr. Dredging Co.	Cache Cr.	Flume	7 close	....	300
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## CIRCLE DISTRICT

29(a) Berry Dredging Co.	Mammoth Cr.	Flume(e)	3½ close	25	150
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## FAIRBANKS DISTRICT

30(a) Fairbanks Gold No. 1	Fairbanks	Stacker	4 close	21	220
31(a) Fairbanks Gold No. 2	Fairbanks	Stacker	3½ open	13	85

## IDITAROD DISTRICT

32(a) Riley Inv. Co.	Otter Cr.	(g)	3½ close	22	110
33(a) Beaton & Donnelly	Otter Cr.	(g)	2½ close	20	110

## INNOKO DISTRICT

34(a) Flume Dredge Co.	Yankee Cr.	Flume	2½ open	14	60
35(b) Flume Dredge Co.	Little Cr.	Flume	2½ open	....	60
36(b) Innoko Dredging Co.	Gaines Cr.	Flume(c)	3½ close	....	150

## KUSKOKWIM DISTRICT

37(a) Kuskokwim Dredge	Candle Cr.	Stacker	3½ close	22	140
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- (a) Operated 1922.  
 (b) Under construction.  
 (c) Moving to new location as given.  
 (d) Idle.  
 (e) Rev. Screen and two flumes.  
 (f) Shaking screens.  
 (g) Combination screen, flume and stacker.  
 (h) Auxiliary distillate engine.

DREDGES IN ALASKA, 1922

FUEL USED	Consumption	Digging depth	Capacity	Size of	Manager	
Kind	daily.	below water.	cu. yds. per 24 hrs.	hull.		
Distillate	.....	11 ft.	.....	34x60x5½	J. Kelliher	1
Oil-electric	.....	70 ft.	.....	48x114	J. Keenan	2
Distillate	.....	12 ft.	.....	28x60	.....	3
Crude Oil	200 gals.	25 ft.	2000	36x92x6¼	C. Mitchell	4
Distillate	200 gals.	15 ft.	1500	30x60x5½	J. Matthews	5
Distillate	.....	12 ft.	900	24x44x4-1/3	E. Pierce	6
Crude Oil	220 gals.	30 ft.	2000	35x74	A. Anderson	7
Distillate	100 gals.	12 ft.	1000	28x60	C. L. Peck	8
Distillate	110 gals.	12 ft.	900	26x50	S. Fernegal	9
Distillate	132 gals.	16 ft.	1000	30x60	A. N. Kittleson	10
Distillate	.....	15 ft.	.....	30x60x5½	.....	11
Diesel-Elect.	220 gals.	20 ft.	3000	40x86	R. S. Oglesby	12
Distillate	100 gals.	12 ft.	800	24x56	H. Fries	13
Distillate	55 gals.	7 ft.	500	16x30x2½	A. N. Garrod	14
Crude oil	100 gals.	18 ft.	1000	26x50x4-1/3	J. J. Guinan	16
Diesel-Elect.	.....	40 ft.	6000(m)	56x115x11½	.....	16
Diesel-Elect.	.....	60 ft.	6000(m)	56x140x11½	.....	17
Distillate	.....	18 ft.	1500	30x62x5½	.....	18
Distillate	55 gals.	10 ft.	500	25x55	P. Iversen	19
Distillate	140 gals.	15 ft.	1000	30x60	V. Julian	20
Distillate	.....	15 ft.	2000(m)	30x62½x5½	.....	21
Distillate	130 gals.	15 ft.	1000	28x60	G. Russell	22
Crude oil	120 gals.	15 ft.	1500	.....	A. Nylan	23
Distillate	.....	.....	.....	.....	G. C. Mahla	24
Hydro-elect.(h)	.....	21 ft.	2200	36x75x6½	F. Ayer	25
Crude oil	180 gals.	20 ft.	1800	32x96	F. Ayer	26
Distillate	110 gals.	13 ft.	1000	24x46x4-1/3	.....	27
Hydro-Elect.	.....	.....	4000	54x87	J. W. Boles	28
Wood	3½ cords	16 ft.	2200	30x62½x5½	Wm. Heitman	29
Crude Oil	260 gals.	30 ft.	2500	40x90x6	G. Aarons	30
Wood(k)	5 cords	23 ft.	1000	38x90	.....	31
Crude oil	160 gals.	15 ft.	2000	30x62½x5½	S. Atwell	32
Crude oil	160 gals.	.....	1600	30x60x5½	Jno. Beaton	33
Distillate(l)	100 gals.	12 ft.	1000	28x60x4	J. Saupe	34
Distillate(l)	.....	12 ft.	1000(m)	28x60x4	J. Saupe	36
Wood	8 cords	18 ft.	2200(m)	38x66x5½	.....	36
Crude oil	200 gals.	35 ft.	2200	36x90x6-1/3	T. Aitken	37

- (i) Old Three Friends Dredge.  
 (j) Old Blue Goose Dredge.  
 (k) Changing to Diesel crude oil.  
 (l) To install hydroelectric plant.

(m) Anticipated yardage.

In 1921, 24 dredges were operated, handling 2,799,519 cubic yards of gravel from which the average gold recovery was 57 cents per cubic yard, or 37% of the placer gold produced. (2)

#### Placer Mining Operations in 1922.

The methods of placer mining used in Alaska are: Dredging; various forms of hydraulic mining; steam scraper and drag-line excavation; drifting, during both summer and winter, by shaft and in a few instances by adit; and the more primitive methods of ground-sluicing and shovelling-in.

In 1922, 23 gold dredges were operated, producing about \$1,530,000 worth of gold. (1) This is about 37% of the total placer gold produced. During the year 15 dredges were operated on Seward Peninsula, 2 on Otter Creek in the Iditarod district, 1 on Candle Creek in the Kuskokwim region near McGrath, 1 on Yankee Creek in the Innoko district, 1 on Cache Creek in the Yentna region, 2 on Fairbanks Creek in the Fairbanks district, and 1 on Mammoth Creek in the Circle district.

The season of 1923 will show an important increase in the number of dredges operated. New construction is under way, and some of the dredges on the Seward Peninsula that have been idle for a number of years will again resume operations. As a result of investigations conducted over a period of several years, the two largest dredges in Alaska are being constructed near Nome. These dredges are equipped with 9-cubic-foot buckets, digging 40 feet and 60 feet below water level. Each one is expected to dig about 200,000 cubic yards per month. The operation of these modern dredges under up-to-date and systematic management will mark a new era in Alaska gold dredging.

While three of the small Seward Peninsula dredges finished operations during the season, it is reported that two will be moved to new locations. Three or four other Peninsula dredges, which have been idle, will resume operations during the coming season, some of them being moved to new locations.

The transportation of dredges to Little Creek and Gaines Creek in the Innoko district has met with much delay. The dredges are now, however, landed in the district and will be ready to start operations in 1923.

The accompanying table, No. 1, gives the important details concerning Alaska dredges.

Prospecting of placer ground was more active in 1922 than for several years past. The most important work of this kind was conducted on a large and systematic plan on Cleary and Goldstream Creeks in the Fairbanks district, where the dredging possibilities of these creeks were being investigated by strong California interests.

Hydraulic mining methods are being more generally adopted in most of the districts, although, unfortunately, favorable conditions for this kind of mining on anything but a small scale are generally lacking. Conditions for large scale operations, which require sufficient water supply

under suitable head, proper stream gradients and extensive gravel deposits, are found mostly in the mountainous belts lying at a distance from the sea coast, as in the Copper River, Kenai Peninsula, Yentna and adjoining districts. On Seward Peninsula some large water supplies have been made available by extensive ditch systems dug in the early mining days, and, although stream gradients are generally not favorable, the district is still the scene of considerable hydraulic mining. Some form of hydraulic mining was conducted during 1922 in practically every placer district of the Territory. The principal operations of this type were in the Chistochina and Nazina districts in the Copper River Region, on Kenai Peninsula, in the Cache Creek, Kantishna and Circle districts, and on Seward Peninsula. The largest hydraulic elevator operations were conducted on Seward Peninsula, where one of the larger hydraulic elevator plants, long idle, has again been placed on the active list. Preparations are being made for future hydraulic operations in the Copper River and the Kenai Peninsula Regions, and in the Yentna, Bonfield, Chulitna and other districts. Many of the operations in districts not mentioned are conducted on a small scale and in some cases water supplies are so limited during the larger part of the season that water can only be obtained by storage and used in short intermittent periods.

Steam scraper operations and other somewhat similar mechanical operations are limited to those districts affording a fuel available at a reasonable cost. The principal scraper operations in 1922 were conducted in the Fairbanks, Tolovana, Hot Springs, Forty Mile and Iditarod districts. The largest operations were conducted on the Goldstream watershed in the Fairbanks district. The scrapers used are of the bottomless and the slip tooth types. Several cable way excavators and one small drag line excavator were operated in the Fairbanks district and a drag line excavator was operated in the Iditarod region.

Drift mining was conducted mainly in the Fairbanks and Tolovana districts and to a lesser extent in the Hot Springs, Ruby, Chandalar and other Yukon Basin districts where deep gravels are found. But little drifting was done on Seward Peninsula on account of the high cost of fuel and timber. A few of the drifting operations in these districts fortunately struck some good ground and were able to make a good return. Most of the work, however, is in small isolated areas of ground left by former operators and these operations employ from 3 to 12 men each. Operations employing 15 men or more are rare. The day of drift mining is rapidly passing, although the past year has seen an increasing number of these small operations.

The more primitive methods of ground-sluicing and shovelling-in are used in all the districts, the work being conducted by one man or by groups of two or three men. The day when this form of small scale mining can be profitably conducted has practically passed in most of the districts, but such operations afford a meager livelihood for a large number of prospectors.

(2)—Alaska Mining Industry in 1921—U. S. Geological Survey Bulletin No. 739-A.  
(1)—Mining in Alaska in 1922. Advance Statement, U. S. Geological Survey.

TABLE NO. 2.—ALASKA FREIGHT RATES, 1922

Seattle to—	Ketchikan	Juneau	Cordova	Anchor- age	Nenana Fairbanks Via Sew- ard 1.50 Via Gov. Ry. (b)	Nome at anch- orage (c) Ligherage additional	Nome Lighter- age 50c-\$1.00	Kotzebue at anch- orage \$8. to tional light- erage (c)	St. Michael at dock (d)	Seattle charge wharfage & handling additional
Wharfage charge additional..	\$ 1.00	\$ 1.00	\$ 1.50- 1.60	\$ 1.50						
Coal in sacks per 2000 lbs. ....	4.50 4.50	5.50 4.50	7.50 5.00	8.50 6.00	..... .....	\$15.65 13.65	\$ 8.00 .....	\$17.00 14.00	\$23.00 20.00	..... \$1.05
High explosives— Dynamite .....	20.00 17.00	20.00 17.00	26.50 21.50	31.50 24.00	\$168.00 84.00	35.50 33.00	12.00 .....	60.00 53.00	52.00 47.50	..... 2.75
Freight N.O.S. ordinary General groceries General merchandise }	8.00 ..... .....	9.00 ..... .....	13.50 ..... .....	15.50 ..... .....	51.00 to 84.00 42.00 (e)	19.00 16.00 .....	10.00 ..... .....	29.00 21.00 .....	28.00 23.50 .....	..... 1.05 .....
Lumber—common usual lengths per M .....	9.50 8.50	10.00 9.00	16.50 16.00	18.50 17.50	51.00 27.00	23.00 21.00	8.00 .....	27.50 25.50	30.50 28.50	..... 1.00
Mining machinery in pieces not over 4000 lbs. (a) .....	8.00 .....	9.00 .....	13.50 .....	15.50 .....	51.00 42.00 (e)	16.00 13.50	8.00 .....	27.00 17.50	24.50 20.50	..... 1.05
Oils—explosive 110 gal. drum at 24 cu. ft. ....	10.00 .....	10.00 .....	22.50 14.50	23.50 15.50	59.00 42.00	20.00 16.00	12.00 .....	25.50 21.00	31.50 25.50	..... 1.75
Oils—fuel, engine, etc. 110 gal. drum at 24 cu. ft. ....	8.00 .....	9.00 .....	13.50 .....	15.50 .....	59.00 42.00	18.00 15.00	8.00 .....	25.50 20.50	29.50 23.00	..... 1.75
Return or South Bound— Carriers, empty drums .....	3.50 .....	3.50 .....	4.25 .....	4.75 .....	51.00 32.00	3.50 3.50	..... .....	4.50 4.50	7.00 7.00	..... .80
110 gal. drum at 24 cu. ft. Ore and concentrates— 25% added for each 100% over value of \$50.00 ton .....	4.00 ..... .....	4.00 ..... .....	6.50 4.75	7.50 6.00	20.00 13.50 (b)	7.50 7.50	..... .....	9.00 .....	13.50 11.00	..... 1.05

Rates are per ton of 2000 lbs. or 40 cu. ft., unless otherwise specified.

\*Upper figure—less than carload lot rate. Lower—carload lot rate.

(a) Additional charge for pieces over 4,000 lbs.

(b) Transfer charge at Nenana—\$3.00 per ton additional.  
Rates per 2000 lbs.

(c) Ligherage charges additional.

(d) Ligherage charges at St. Michael already added.

(e) In mixed carloads, minimum wts. 12 to 15 ton lots.

Seattle wharfage and handling charges and local wharf-  
age are additional.

TABLE NO. 3.—ALASKA FREIGHT RATES—1922—YUKON  
RIVER POINTS VIA ST. MICHAEL

LESS THAN CARLOAD LOTS Seattle to—	St. Michael	Marshall	Holy Cross	Iditarod	Koyukuk Ruby Tanana	Rampart	Beaver	Circle	Eagle
Coal in sacks per 2000 lbs...	\$23.00	\$38.00	\$44.00	\$82.00	\$44.00	\$ 50.00	\$ 66.00	\$ 70.00	\$ 72.00
High explosives—Dynamite..	52.00	76.00	88.00	126.00	88.00	100.00	132.00	140.00	144.00
General groceries, hard- ware, merchandise .....	28.00	38.00	44.00	82.00	44.00	50.00	66.00	70.00	72.00
Lumber—common per 1000 ft. B. M. ....	30.50	47.50	55.00	93.00	55.00	62.50	82.50	87.50	90.00
Mining machinery (a) pieces not over 2000 lbs. per ton	24.50	38.00	44.00	82.00	44.00	50.00	66.00	70.00	72.00
Oils — explosive 110 gal. drum at 24 cu. ft.....	31.50	38.00	44.00	82.00	44.00	50.00	66.00	70.00	72.00
Oils—fuel, engine 110 gal. drum at 24 cu. ft.....	29.50	38.00	44.00	72.00	44.00	50.00	66.00	70.00	72.00
Return or south bound— Carriers, empty drums 110 gal. drum at 24 cu. ft....	7.00	15.50	19.00	37.50	22.00	25.00	29.50	31.50	32.50
Ore — Concentrates, value not over \$200 per ton.....	13.50	31.00	38.00	75.00	44.00	50.00	59.00	63.00	65.00

Rates are per ton, or 2000 lbs. or 40 cu. ft., unless otherwise specified.

(a) Additional charge for pieces weighing over 2000 lbs.  
Freight on upper Yukon above Rampart generally shipped  
via White Pass Ry.

Wharfage and handling charges additional.

### Transportation.

Transportation conditions have always constituted a serious handicap to the Alaska mining industry. The completion of the Alaska (Government) Railroad connecting tidewater with Interior Alaska has been one of the greatest steps in improving interior transportation. It has placed the interior in a position to obtain supplies during the entire year at a reasonable cost and has made some of the districts more readily accessible. This had led to a reduction of mining costs and has been reflected in increased placer mining activities in the districts affected. However, with the completion of the railroad, transportation on the Yukon practically ceased. There were only four trips made during the 1922 season by a regular river boat. This service was augmented by weekly trips of the mail launches, which also carried passengers, from St. Michael to Tanana, and a trip every two weeks on the upper Yukon. On the Tanana, the only service furnished was by irregular trips of small river boats plying between Nenana and points down river as far as Holy Cross and from there to Iditarod, and weekly trips of launches between Nenana and Tanana. This condition will, however, be bettered in 1923, for the Alaskan Engineering Commission has been authorized to operate two river boats formerly assigned to the Army and will inaugurate a service in connection with the railroad between Nenana and Yukon River ports. In tables 2 and 3 the ocean and river freight rates from Puget Sound ports to the principal Alaska centers and joint rates to Fairbanks via the Alaska Railroad are given. Further mention of these rates and overland transportation costs are made in accompanying reports on individual districts. The high cost of transportation to these centers is further increased by the overland haul which in itself amounts in many cases to much more than the ocean freight, and, except in the case of a property located within a reasonable distance of a road system tributary to the main distributing point, this charge becomes prohibitive. For this reason the more isolated districts have experienced a rapid decline and have been slow in subsequent development. The urgent necessity of improving these conditions is one of the best arguments to be advanced for more road building; or at least for the construction of suitable trails. Seward Peninsula has been handicapped not only by high freight rates due mainly to heavy lighterage charges, but by natural conditions affecting coastal traffic. Storms along the coast make it difficult to reach many districts by water, and overland transportation facilities from Nome to distant points along the coast are lacking.

In the purchase of the Seward Peninsula railroad, which will be placed in condition to allow the haulage of light freight and passengers on flat cars drawn by dogs, the Kougarok and Fairhaven districts will be greatly helped.

To facilitate passenger travel and the dispatch of mail many communities have given serious consideration to the establishment of air transportation service. This is not a new idea, but the possible benefits to be derived make the plan worthy of early development.

In 1922 Alaska experienced one of the coldest and wettest summers that has occurred since placer mining has been conducted in the Territory. Prolonged cold rains were general throughout practically the entire Territory. This condition was a handicap to dredging operations, for not only did the cold weather retard the natural thawing of the gravels, but many of the operations were further delayed by high floods. Scraper operations in the interior were hampered to an unusual degree by the slow thawing of the gravels. Hydraulic operations derived benefit from the increased water supply, but on the whole it was an adverse summer.

## REVIEW OF PLACER MINING BY DISTRICTS

Following herewith are detailed reports by districts, in which are given brief accounts of the more important operations and developments.

### COPPER RIVER REGION

The principal placer mining operations in the Copper River Region in 1922 were those conducted at the large hydraulic plants on Dan and Chititu Creeks, tributary to the Nazina River, south of Kennecott, and those conducted on Slate Creek, near Dempsey.

In the Chistochina section the Slate Creek Mining Company operated its hydraulic plant on Slate Creek and another one was operated on Miller Gulch.

The Dan Creek Mining Company operated one hydraulic plant on Dan Creek.

John E. Andrus, employing from 40 to 50 men, operated two hydraulic plants on Chititu Creek, where during 1922 approximately 24,600 square yards of ground, averaging 6 feet in depth, were handled at the No. 9 operations, and 4,600 square yards, averaging 15 feet in depth, on No. 1. According to the general manager, Mr. Bert Carvey, the ditch supplies an average of 4,000 miners' inches of water under a 350-foot head. Only creek gravels are now being handled. The average working season for hydraulicking is from 125 to 130 days in extent, though in some years it lasts 150 days. The slate bedrock is soft and easily piped. Grade is sufficient for box grades but tailing is stacked by giant. A considerable number of large boulders are encountered, which are blasted or removed by donkey hoist. From 3 to 5 tons of powder are used each season in the blasting of the boulders. The pits worked average 1,000 feet in length and 300 feet in width. A 4-foot rock sluice is dug and blasted through the center of the new area for the entire length. A giant is set on each side of the sluice and the material is piped to and into the sluice and goes to the boxes, which are set at the lower end. In cleaning up this sluice a hose and small nozzle is used and the content is washed down and into the boxes.

Several small operations were conducted on Rex Creek and some drifting was done in bench deposits reached by adit. A number of outfits were working on a small scale and others were prospecting on Young Creek.

### KENAI PENINSULA REGION

Placer mining was conducted during 1922 on Crow, Resurrection, Canyon, Mills and Bear Creeks. Six hydraulic plants are reported to have been operated, the largest being that on Crow Creek, in the Girdwood district. Numerous small ground-sluicing operations were conducted throughout the region, most of which were on Bear Creek. The gold output for 1922 was small. Placer labor receives \$5.00 and board per day of 8 hours. It costs from \$1.75 to \$2.00 per day to board a man.

At several of the larger hydraulic plants that have been idle during the past season preparations are being made to resume operations the coming year.

#### Girdwood District.

Denhart and Holmgren operated the Crow Creek Hydraulic Mines, six miles from Girdwood, with a crew of about 20 men. They have given a "lay" to Erickson and Totland, who will operate the property next season.

#### Sunrise District.

The Canyon Creek Development Company, under the management of N. O. Anderson, is constructing a hydraulic filled timber dam on Canyon Creek. It is reported that this dam is to be 110 feet high. It will divert the water from the creek bed and thus allow the creek gravels downstream from it to be hydraulicked. It will also provide some of the water to be used in mining operations. The company expects to have this work completed and start mining next spring.

Allison and Plowman, working alone, operated a hydraulic plant on Canyon Creek and Bob Michaelson reports successful prospecting results on Mills Creek. No placer mining is reported on Lynx or Palmer Creeks.

#### Hope District.

The Matheson Brothers hydraulic plant has been idle, but will be actively operated the coming season. A half interest in the plant has been acquired by J. E. Ketchum of Cordova. Togstad, Beaswanger and Carlstrom operated their hydraulic plant on the Busy Bee Claims. The Russians hydraulicked on ground above the Pearson property, the latter being idle. Haun Brothers conducted hydraulic operations on the Carson ground and Capovich and McComb ground-sluiced on a bench near the mouth of Resurrection Creek. About 12 men were ground-sluicing on Bear Creek. Ed Belmont plans to install a hydraulic plant on this Creek.

### SUSITNA REGION

#### Yentna District.

The gold production for 1922 from the Yentna or Cache Creek District will show a large increase over that of 1921. The increased output is due to the successful season experienced in the operation of the Cache Creek dredge and to the good water supply, which, owing to the wet season, was available to the 14 hydraulic plants operated on Cache and Peters Creeks and their tributaries. Operators of hydraulic plants all report a fine season, and plans are being made at several properties to enlarge the scale of operations. Five of these hydraulic plants are being worked on a very limited scale, using water under low head through canvas hose; the others have standard equipment, using, as a rule, No. 1 Giants with water up to 210-foot heads.

The gravels of this district are frozen only during the occurrence of seasonal frosts. In general the creek deposits mined are from a few feet to 12 feet in depth and contain coarse gold. Deep bench ground is hydraulicked on Dollar, Falls, Thunder and Bird Creeks. About 100 men were engaged in mining. This district was formerly reached via the Susitna River, but since the completion of the Government Railroad, Talkeetna is the point of access. It is 45 miles from Talkeetna to Cache Creek. Fifteen miles of fine wagon road has been completed, the rest of the distance being covered by trail. This piece of road has been under way for the past three or four years and it is hoped will be rushed to an early completion. Freight cost from Talkeetna to Cache Creek during the summer is 20 cents per pound. Winter freight is \$65 per ton. The benefit of a completed road can be readily seen. Wages are \$5.00 and board per 8-hour shift. Board costs \$2.00 per day. Lumber at Talkeetna sells for \$35 per thousand.

#### Cache Creek.

The Cache Creek Dredging Company reports a very successful season regardless of two floods which stopped operations for 26 days. Dredging started May 17th and continued to November 5th. The ground removed averaged 9 feet in depth and a total of 398,323 cubic yards were dug. This dredge was formerly steam operated, using lignite fuel mined close by. The dredge is now electrically operated, the hydro-electric plant having been completed in 1921. This change has brought about a big saving in power cost as well as improving conditions on the dredge. The plant consists of a 23-inch double discharge Leffel turbine water wheel, operating a 300 KW alternating current General Electric generator delivering current at 2,300 volts.

On upper Cache Creek, Dick O'Rourke and one man are piping in 6 to 10 feet of gravel with a No. 1 Giant.

#### Dollar Creek.

Hillman and Barhenberg conducted successful hydraulic operations in deep bench ground on the B & B claim, operating from June 7 to

October 20, with a crew of nine men. Work this summer was carried on along a 1500-foot cut having a bank from 175 to 200 feet high. Water under 200-foot head is piped against the face, the material washed down being piped into the boxes. A string of 140 boxes is used, dumping the tailing in the Canyon below. Plans are under consideration to hydraulic the shallow creek gravel at the mouth of the Creek.

#### Short Creek.

H. Price and two men using water under low head through canvas hose equipment piped in shallow creek gravel.

#### Falis Creek.

Geo. Anderson, with about eight men, using two giants piped in four to eight foot creek gravel. Frank Irvin, with six men, hydraulicked deep bench ground.

#### Thunder Creek.

Al Wolf, with a crew of six men, hydraulicked deep bench ground. Plans are reported to be under way to more than double the scale of operations next summer.

#### Nugget Creek.

The Nugget Creek Hydraulic Company, with 7 men, worked shallow creek gravels. An abundant supply of water is obtained through 3 miles of ditch at a 200-foot head. One No. 1 Giant is used for stacking tailing.

#### Peters Creek.

Harper Brothers, with a crew of 7 men, continued their hydraulic operations after digging 3 miles of ditch. The natural grade of Peters Creek averages 2½%. A short string of 30-inch boxes, composed usually of not over 3 lengths, are set on 6-inch grade. The gravel is of medium size with but few boulders and averages 5 feet in depth. The conglomerate bedrock is readily cleaned with the giant. A No. 1 Giant under 210-foot head is used to pipe into the head of the boxes and a No. 2 giant with 3-inch nozzle is used to stack the tailing. An operating cost of 6 cents per square foot is reported.

Shell, McDonald and others have purchased the Harper Bros. interests and plan to operate next summer on an enlarged scale.

Elmer Carlson and one man hydraulicked with one giant on lower Peters Creek.

#### Other Creeks.

Among those operating on other creeks, hydraulicking shallow ground with the use of canvas hose outfits, were Chris. Hammersmith on Bird Creek; Frank Jenkins, and Rice and Hatch on Willow Creek; Cast and Mack on Poorman; Andreassen and Wetherell on Gold Creek. Bedar, Gray and Vest were ground-sluicing on Clear Creek.

#### Valdez Creek District.

The largest operations to be conducted in the Valdez Creek District this year were those of the McKinley Placer Mining Company on Valdez Creek. This Company operated its large hydraulic plant, although the season's operations are stated to have been handicapped by the excessive number of boulders encountered.

#### Chulitna District.

The Three Forks Mining Company have been prospecting the gravels of the Chulitna River at Mile 287½ on the Government Railroad. It is reported that about 15 men will be employed during the winter sinking prospect shafts and that a large hydraulic plant will be installed next spring.

#### Talachulitna District.

This district lies at the headwaters of the Skwentna River, in the Rainy Pass country. Prospectors returning from this district report the finding of extensive, deep, auriferous gravel banks along several of the larger creeks. Conditions are reported very favorable for hydraulic mining.

### KANTISHNA DISTRICT

For a description of placer mining operations in the Kantishna District the reader is referred to the special article on the Kantishna Region by Mr. John A. Davis, in the latter part of this report.

### BONNIFIELD DISTRICT

This district, while in part a portion of the Nenana coal field, has been placer-mined more or less for the past 20 years, producing in 1921 about \$16,000. While the gravels are of low grade, some extensive areas are reported that would justify prospecting. The district is difficult of access owing to lack of roads, and, while the Government Railroad has now made it more accessible, the creeks being worked are from 20 to 40 miles east of the railway line. The gravels are in creek deposits and, while frozen in places, are mostly thawed. The average season is from June 1st to October 1st.

Fairbanks interests have taken over the Keevey ground on Gold King Creek and are installing a hydraulic plant and expect to be ready to operate during the coming season.

Val. Diebold installed a small hydraulic plant on Platte Creek during the past season and operated to the close of the season with a crew of five men. Further ditch construction is planned to increase the water supply. This property is reached by trail from Hoseana on the railroad from which it is 22 miles distant. Heilig and Smith on Thistle Creek are preparing to hydraulic, and ground-sluicing was done on Margaret Creek and on the headwaters of the Totalanika River and on the Tatlanika River.



### FAIRBANKS DISTRICT

Placer mining in the Fairbanks district has shown a marked increase during the past year, both in the number of operations conducted and the gold output. It is estimated from early reports that the placer gold production for 1922 will show an increase of about \$200,000 over that of the preceding year, when a production of \$570,000 was reported. This advance is attributed mostly to the increased production from drift mines at Dome, Little Eldorado, Gold Hill and Ester Creeks, where some small blocks of high grade gravels were mined, and also to the successful dredging operations on Fairbanks Creek. The steam scraper plants as a whole have had a bad year, because of the cold wet weather that prevailed during the summer and greatly retarded the natural thawing of the gravels.

The Government Railroad has made Fairbanks an "all-the-year" camp, as it is now possible to obtain supplies from the States at all times on short notice. The operation of the railway has also demonstrated its beneficial effects in many other ways. Locally, the cost of supplies is still high; probably higher than is justified. Freight rates via the railroad are being reduced. A new joint tariff has been made on carload lots, providing for a rate of \$42.00 per ton on mining machinery, oils and general groceries, between Puget Sound ports and Fairbanks. See table 2. For transfer across the Tanana River at Nenana a charge of \$3.00 per ton is added on freight and \$.50 per ton on coal. This charge will be abolished on completion of the Nenana bridge early this spring. The narrow gauge branch of the railroad as well as auto stages complete the haul from Fairbanks to the Creeks.

Very little coal has so far been used in the placer operations. As a better quality of lignite is now being mined at Healy, which is delivered in carload lots at Fairbanks for \$4.50 per ton, its use will be more generally adopted.

Most of the wood used for mine power purposes is cut on lower Goldstream Creek, where it costs \$8.00 per cord on the car. At most of the properties, the cost of wood is from \$10 to \$14 per cord, which includes freight and hauling from the siding. Wages for labor amounts to \$5.00 per day and board, on an 8-hour basis. Pointmen and nozzle men receive \$6.00. Steam scraper engineers receive \$8.00 to \$10.00 per day and board. Board costs from \$1.75 to \$2.50 per day.

More prospecting is being done than for some years past, and of particular interest is the drilling which has been done on Cleary and Goldstream Creeks by the Humphries-Bigelow Co., representing the foremost California dredging interests.

The following are the principal placer operations conducted during the year:

#### Goldstream.

H. Atwood, F. C. Bleecker, Henry Wagner, Rögge-Wagner and Chas. Grill operated Bagley scraper plants on Goldstream, a total of 60 men being employed in their operations. A. Hanot on Discovery with a crew of

12 men took out a small pit with a cableway or trolley excavator. A similar outfit was operated by A. Zimmerman on Twin Creek. Both of these operations contended with unusually adverse conditions.

#### Gilmore Creek.

James McPike on No. 3 below Gilmore operated a 2-yard Bagley scraper plant with a crew of 12 men. An old pit was completed. A new pit, 300x400 feet, was opened but only partly cleaned up before cold weather set in.

#### Pedro Creek.

Guis and Krize on No. 7 below installed a hydraulic plant and were able to take out several cuts before the freeze-up. A total of 10 men were employed.

Nelson and Zimmerman on No. 2 above continued hydraulic operations up to the first cold spell, September 25th. The ground worked averaged about 15 feet, with a creviced and blocky gneiss bedrock which required cleaning by hand. Two No. 2 giants are used under 120 feet head for "piping in" and two No. 1 giants for stacking tailing, only one of each being operated at one time. About 24,000 sq. ft. of ground was worked at an operating cost of \$.30 per sq. ft.

#### Fairbanks Creek.

The Fairbanks Gold Dredging Company operated its two dredges, employing about 30 men. A most successful season is reported. The old Risdon dredge is being overhauled and will be changed from steam to Diesel power. This dredge, using steam, consumed 5 cords of wood per day at a cost of \$130.00, the long, heavy tractor haul from Gilmore Railroad station bringing the cost to \$26.00 per cord. The new plant will consist of two 60 H. P. Werkspoor Diesel engines estimated to consume about 135 gals. of crude oil per day at \$.40 per gal., or \$54.00 per day.

#### Cleary Creek.

Ten small operations, consisting of three small drift and seven ground-sluicing operations, were conducted on upper Cleary Creek and its tributaries, Wolf, Chatham and Bedrock Creeks. A steam scraper was operated for a short time at the mouth of Bedrock, and Pearson and Johnson did a little drifting on No. 6 below Cleary. Sam Weiss with a crew of 8 men on No. 16 below Cleary took out about 16,000 sq. ft. of gravel, mining from an old 80 ft. shaft. Two levels of "pay" were found. Schaup and Larsen with a crew of 5 men drifted on the Hope and Totem claims on Chatanika Bench. Three Keystone drills were operated on Cleary Creek and around Chatanika by the Humphries-Bigelow Co.

#### Little Eldorado.

The Idaho Mining Co. on the Idaho Association claim conducted drifting operations with a crew of 11 men. The ground is 160 feet deep and

the gravel is tightly packed. A small air compressor is being operated to deliver air to a Jackhammer drill-type BCRW 430. With this outfit one man drills on an average of 20 9-ft. holes in 8 hours and sets the sweaters in these holes. Before adopting this system it took 2 men 8 hours to set from 4 to 6 of these points.

Rehn and Freeman with 11 men, Hans Hess & Co. with 7 men and Andresen & Co. with 10 men were drifting "side pay" and old pillars.

Three or four small outfits drifted on ground farther up the creek. Some drifting is also being done on the creek this winter.

#### Dome Creek.

Kinney and Gillis did some drifting and additional drilling. They are sinking a new shaft this winter and will drift on ground prospected on the Diamond C. Claim.

Cameron and Hansen with a crew of nine men are drifting on an over-looked block on No. 4 above. The shaft is 100 feet deep and in a block stated to contain about 30,000 sq. ft. of ground averaging close to \$2.00 a sq. ft.

Magnuson and Anderson and Shermer Bros. were "sniping" side pay in 180 ft. ground on the Niggerhead Association at the mouth of Dome Creek.

#### Vault Creek.

Honkamen, Niemi & Co. were drifting on the Alabama Claim at the mouth of Vault, and several other small outfits were working farther up the Creek.

#### Engineer Creek.

Sanson, Gove and Hughes continued drifting on Engineer Creek, employing 9 men. A new shaft is being sunk this winter.

#### Ester Creek.

Sholseth & Co. operated on Gold Hill in 110-foot ground which was thawed and dry. A. Benson tried underground sluicing on Pioneer No. 2. Excess water and fine material was conducted through a bedrock drain, the coarser material being hoisted by a self dumper. Difficulty was encountered in holding the roof.

Driscoll & Co., Ed. Hess & Co., Nyland & Co., and Swanson & Co. conducted drifting operations on a small scale on Ester Creek. Six or more operations were to be carried on this winter. Kinney and Cosgrove are drifting on Happy Creek this winter.

#### Nome Creek.

McClelland and Opdyke operated a small locally constructed drag-line line excavator with a 40-foot boom and  $\frac{3}{4}$ -yard bucket. A 20 H. P. boiler produced the power. Three men were engaged in the operations and satisfactory results are reported.

## CIRCLE DISTRICT

Early reports from the Circle district show that the district had a very successful season and a large increase in gold production was made. This increase is due to the resumption of the Berry dredge operations and the unusually wet season, which was of great aid in open cut operations.

The Berry dredge, at its new location on Mammoth Creek, started dredging on July 2nd. In the 92 days operated, 187,132 cu. yds. were dredged. Frost encountered delayed the operations.

The C. J. Berry hydraulic plant was operated with a crew of 10 or 12 men on Eagle Creek, and Jack Anderson with about 20 men operated two hydraulic plants on Mastodon Creek. Most of the other operations, including a few winter drift mines, were small.

## TOLOVANA DISTRICT

Reports from the Tolovana district for 1922 indicate that the gold output will be about the same as produced in 1921, when the production reported was \$285,000. The unusually wet season has been a great help to the district, which has in average years suffered from a lack of water for mining operations. From 150 to 200 men have been engaged in mining during the season. While the drift mines are rapidly diminishing in number, several comparatively large mines are still being operated on Amy and Livengood Creeks. For the most part drift-mining has reached a point where small outfits are working ground left behind by former operations. More attention is being given to the mining of the shallower creek and bench gravels by ground-sluicing and small hydraulic operations.

Livengood or Brooks is the main camp of the district and receives the summer freight for the district via the Tolovana River. At ordinary stages of water, freight is brought from Nenana by small boat and scow. It is transferred around the "Log Jam" by tram, delivered to another fleet and taken upstream to Trappers Cabin, or to West Fork, if water permits. It is then transported by trail to Livengood. Freight is delivered in this way for 10c per lb. Winter freighting is done from Olmes or Dunbar at a rate of from 5 to 6c per lb. Even with this high freight charge, with labor at \$5.00 per day and board (cost of board \$2.50 to \$3.00 per day per man) and with wood costing from \$8.00 to \$9.00 per cord, the cost of drifting 80 ft. ground, as reported by operators, varies from 60c to \$1.00 per sq. ft., the average being 75c sq. ft.

The following are some of the operations conducted during the season:

#### Amy Creek.

Arndt and Moran with about 15 men drifted on a new block of ground during the summer and will continue during the winter. J. Nielson operated an open cut at the head of Amy Creek this summer and will do some drifting this winter.



**Livengood Creek.**

Jurick and Radak with about 15 men will mine on No. 16 above this winter. The ground is reported to be easy to work. The "pay" occurs in "chicken feed" gravel and averages about \$1.00 to the sq. ft.

Tony Silva is sinking a new shaft on ground struck this summer and will work 7 or 8 men this winter. This block of ground is stated to be 60 ft. wide and to yield an average of about \$1.00 per sq. ft.

J. McClelland with a small crew conducted hydraulic operations. Several other outfits mined by drifting method and prospected on the creek. Drilling was done on Ready Bullion Creek and lower Livengood.

**Lillian Creek.**

M. Begler with one man hydraulicked bench ground on No. 1 above Discovery, using a canvas hose outfit with intermittent splashes of water. Barker and Godfrey and Chas. Lynn also operated.

**Olive Creek.**

There were two summer operations on this creek. J. B. Hudson operated a steam scraper plant. The gravels at the mouth of Olive Creek are being considered for dredging.

**Gertrude Creek.**

Ground-slucing operations were conducted on two properties during the summer.

**Wilbur Creek.**

Several open cuts were worked this summer and some prospecting was done. Last winter Enstrom Bros. and Patterson, Wurzbacher, Healy and Koda and Brown Bros. operated. There will be several underground operations on the Creek this winter.

## HOT SPRINGS DISTRICT

During 1922 there were 30 mining operations conducted in the Hot Springs district in connection with which about 80 men were engaged. There is great diversity in the mining methods used in the district, most of the Alaskan methods in some form, excepting dredging, being in evidence.

In the Tofty section, where some of the gravels carry a considerable amount of tin concentrate, operations will be materially assisted by the increase in the price of tin. The district has produced as a by-product of gold mining, about 300 tons of tin concentrate containing about 60% tin. Hitherto, as a result of the low price of the metal and the high freight rates prevailing but little attention has been given to the presence of tin.

The Hot Springs district now obtains its supplies through Nenana. Freight from Nenana to Hot Springs Landing is carried by small launch and scow at a cost of from \$20.00 to \$30.00 per ton. American Creek re-

ceives its supplies from Tanana via Fish Lake at a freight cost of 3c per lb. From Hot Springs Slough there is a wagon road, 11 miles in length, to Tofty, with a branch road 5 miles farther to Woodchopper. Freight rates from the slough to Tofty are 2½c per lb. and to Woodchopper 3c per lb. A first class road connects Hot Springs and Eureka, a distance of 24 miles. Eureka is practically a separate district. The freight to Eureka is hauled by tractor at a cost of \$55.00 per ton.

Had the wet season of 1922 been anticipated by the operators much benefit would have been derived from the increased water supply. Provision had not been made, however, to take advantage of the unusually favorable conditions that the season afforded and, unfortunately, the operators failed to profit greatly from them.

Wages for labor in the district are \$5.00 per day and board. Board costs \$2.50 to \$3.00 per day.

**Tofty Section.**

Cleveland and Howell, employing 8 men, have opened one of the largest hydraulic pits in the district, on the benches back of Tofty. The ground, part of which was formerly drifted, averages 50 feet in depth, interbedded layers of frozen muck and silt overlying the 3 to 5 ft. of gold and tin bearing gravel. This muck and silt was formerly removed by the aid of ground-slucing in deep cuts with the assistance of four giants, and by the undercutting and caving of the banks; the fine material and water being carried off through a long open drain. Last spring some 10 ft. points using cold water were tried and with the combined nozzle and thawing action of this water under pressure the muck was quickly honey-combed and could then be more easily removed with the giants. The results obtained by this experiment were so satisfactory that the same principle will be adopted next spring on a larger scale using 20 and 40 ft. points. The spacing of the points and time required are still matters for experiment.

After the muck has been stripped off, the gravel is piped to a small Hendy elevator, elevated 15 ft. to sluices, the tailing being stacked with a giant. There is an insufficient water supply during the larger part of the season. Future operations will dispense with the elevator and the system of "piping over the side" will be adopted.

**American Creek.**

Ed. Ness with a crew of 6 men operated the only steam scraper plant in the district. The ground mined averages 9 feet in depth. About 3½ ft. of muck and light gravel is stripped by ground-slucing, the "pay" gravel being dug and conveyed directly to the elevated sluice by a one-yard slip tooth scraper. One cut just an acre in size was taken out during the season and a new area stripped for the next season.

Others mining on American Creek were M. Murray, who was ground-slucing with an automatic gate; Gallon & Miller, who were drifting, and H. Besonen and partner, who were ground-slucing and prospecting.

### Other Creeks.

L. Anderson, A. Mathoone, and Fredlund and Nurstes conducted open cut operations on Boulder Creek. Otto Hovely drift-mined on Cache Creek. Hansen and Lindeberg with 2 men drifted during winter and summer in 115 ft. ground on Hokeley Creek. Hosler and Albrecht drifted on a small block of ground on the Mohawk Claim at Woodchopper. Jno. Radovich and 2 men, using a small portable prospecting outfit, did some drifting on Miller Creek and will continue through the winter.

Early reports were to the effect that 5 or more small drifting operations would be conducted during the winter on the Bock ground near Woodchopper.

### Eureka Section.

The Eureka section is characterized by its small hydraulic plants and ground-sluicing operations, most of which depend on an intermittent water supply regulated by automatic dumping or hand operated gates.

The largest of the hydraulic operations was conducted by Frank & Co. on Pioneer Creek. Seventeen men were employed during the spring, but owing to a period of low water, this crew was cut to 6 men and upon a return of better water conditions additional help was not available. Operations at this property consisted principally of the hydraulicking of shallow bench gravels, averaging 7 ft. in depth, on the right limit of the creek. When sufficient water is available two No. 1 giants are used in the pit, with a head of from 60 to 80 ft. and the gravel is piped into head of the boxes. Otherwise, two 2-inch fire nozzles attached to canvas hose are used. Three pits totaling 150,000 sq. ft. were taken out this season. It is stated that twice this amount is handled when water is plentiful. Owing to a cold spell of weather and lack of water, operations at the Frank property were suspended September 7th.

Similar operations were conducted by Johnson, Sundstedt and Johnson near Glenn Gulch; Lane and Lund, on Rhode Island Creek; Sidney Ridge; Farmer and Jones on Eureka Creek, and Frank Stevens on Excelsior Bar. The first four of these operations mined 210,000 sq. ft. of ground varying from 2 to 12 ft. in depth and carrying from 5 to 10 cents in gold per sq. ft. For the greater part of the season they have water only in intermittent splashes of from 5 to 10 minutes at a time. The ditches are used as reservoirs, the water in them being released by automatic or hand operated gates upon reaching a certain level. The average cost of four operations of this type during 1922, including depreciation and interest charges on plant, was 6c per sq. ft. for an average depth of 6 ft.; or 27c per cu. yd.

On Omega Creek, Olsen and Evenson, with a hand operated gate, ground-sluiced and shovelled in 8 ft. ground at a cost of 37c a sq. ft. Erickson and McLeod also ground-sluiced with an automatic gate. A little drift mining was also done on this creek during the winter.

Others mining in the district were Chas. Smith on Alameda Creek, Louis Siler on Thanksgiving Creek, Frank Stevens, J. R. Green and Jno. Malin on Eureka Creek.

## RAMPART DISTRICT

In 1922, nine open cut operations employing 19 men and three winter drifting operations employing 6 men were conducted in the Rampart District. It is estimated that the gold production for the year will not exceed \$20,000.

A wagon road which follows up Big Minook Creek from Rampart is kept in repair to the Six Mile post. There is a branch road going about one mile up Hunter Creek and a good branch road to the head of operations on Little Minook Creek. Most of the mining is from 5 to 9 miles out of Rampart, the main operations being on Hunter and Little Minook Creeks. Freight from Rampart to the camps costs during the summer from 1 to 2½ cents per pound. Winter freighting costs from ½ to 1½ cents per pound.

### Hunter Creek.

A. Ott with one man is operating a hydraulic plant on shallow bench gravels on the left limit of Discovery claim.

The largest operations in the district are those of Chas. Swanson, who is operating a hydraulic plant on the left limit bench on No. 21 above, which is just below Dawson Creek. The ground is all frozen and in the face of the present pit there is 30 feet of muck and 9 feet of gravel. The average size of pits mined is about 200x100 feet. Water supply is obtained from Upper Hunter Creek, being conducted through 4000 ft. of ditch, 600 feet of flume and 5400 feet of pipe line from 19 inches to 7 inches in diameter, with an effective head at the pit of 180 feet. The gravel is stripped of the muck by using two giants on top and one in the pit for under-cutting. Powder is used occasionally to break down the bank. Gravel is piped into the head of 18-inch boxes. The many boulders encountered are carried and piled to one side. Owing to lack of sufficient dump room, a No. 1 Giant with a 2½-inch nozzle must be kept in almost constant operation, stacking tailing. When running full shift six men are hired. Only one pit was opened this season, and, owing to lack of water from July 10th until the first frost in early September, one corner of the pit was not completed. Operations were first started by Mr. Swanson in 1903. The plant was enlarged in 1917.

### Little Minook Creek.

Markoff and Ross, on No. 3 below, completed their first cut, this year, by booming with an automatic boxgate and shovelling-in.

Climie, La Porte and Nelson, on No. 7, using similar methods, took out a cut 600 ft. long by 12 ft. wide, in ground formerly drifted upon and averaging 20 ft. in depth. While drifting on No. 9 claim last winter these men found a nugget valued at \$350.

Others mining in the district are Thos. Gamble, on Hoosier Creek; Thos. Antonsen, on Little Minook, Jr.; Frank Hawley and Geo. Pride, on Slate Creek. All these operators were using booming-gates. O. C. Clemens

did a little ground-sluicing on Hunter Creek, and Geo. Ledger drifted on Idaho Bar. Crocker and Yantiss prospected on Hoosier Creek during the winter.

## RUBY DISTRICT

Early reports indicate that the gold production of the Ruby District for 1922 was about \$120,000, which is a considerable decrease from that of the preceding year. During the year there were about 25 outfits at work in the district, engaging 75 men. Most of the production came from drifting operations on Spruce, Poorman, Flat and Solomon Creeks and from the operations on Trail Creek. One drift mine was worked during the summer on Meketchum Creek and one on Long Creek and several outfits operated on Tamarack and Glacier Creeks. Open cut methods by ground-sluicing and shovelling-in were conducted on Greenstone, Swift, Bear Pup, Trail, Nowitna and Ruby Creeks.

Freight costs in the district are unusually high. A small amount of freight still comes up the Yukon via St. Michael, but, by reason of better service, most of the freight now comes down river by small launch from Nenana. The freight rate from Nenana to Ruby is \$25.00 per ton. See Table 3. There is a good wagon road from Ruby to Long, a distance of 29 miles. All mining operations are being conducted within 25 miles of Long. Those on Flat and Solomon Creeks are the most remote. From Long, an old winter sled trail is used for summer hauling by team and wagon. Much of this trail is through low swampy country and travel over it is exceedingly difficult. From Ruby the summer freight rate to Long is 3 cents per pound; to Greenstone Creek, 9 miles beyond, 10 cents per pound, and to Flat and Solomon Creeks 20 cents to 25 cents per pound. During the winter, when most of the general supplies are taken in, the rate to Long is 2 to 3 cents per pound, and 5 cents to the most remote camps. A bridge was built across the Solatna River this summer, but its usefulness is impaired by the lack of a suitable road leading to it.

Drifting is the principal mining method employed in the Ruby district. The ground being drifted upon varies from 60 to 80 ft. in depth and carries narrow and comparatively short "pay" channels. These conditions add materially to the cost of mining. The average value of the gold content of the gravel mined is from 75 cents to \$1.25 per square foot.

Mining conditions vary considerably on the different creeks. The cost of drift mining (exclusive of cost of plant) as determined from figures obtained at 6 plants, varies from 60 cents to \$1.00 per square foot, and averages 85 cents per square foot when from 4 to 5 feet of gravel is mined. This cost is equivalent to about \$5.00 per cubic yard. The average steam thawing costs are 45 cents per cubic yard. The cost of sluicing is 33 cents per cubic yard. Wood costs from \$8.00 to \$12.00 per cord at the mines. Wages are \$6.00 and board for an 8-hour shift. The average cost of board is \$3.00 per day.

The principal operations in the district are as follows:

### Meketchum Creek.

Farrell and Warren with four men are drifting in ground 80 ft. deep. The pay channel here is from 50 to 75 ft. in width, most of the gold occurring in clayey "sediment" on a blocky greenstone bedrock. Owing to the presence of angular blocks of bedrock in this ground, much difficulty has been encountered in setting the thawing points. To overcome this, a drill of the jackhammer type is used to make holes for the steam sweaters.

### Spruce Creek.

M. D. McCarty and 3 men conducted successful drifting operations on Spruce Creek last winter and continued their work until early summer. The ground mined is 55 feet deep. It is easy to mine, being composed of free-washing gravel. Conditions on Spruce Creek and Tamarack Creek are similar in character and afford the cheapest mining costs in the district. Prospecting on these creeks has been done during the summer and one new shaft will be sunk this winter.

### Poorman Creek.

Dennis Coyle with 7 men conducted one of the largest drifting operations in the district. The ground on his property is 80 ft. deep and the gravel contains much ice. Some heaving ground and water encountered in one portion of the workings have added materially to the cost of mining.

True Manuel and 2 men operated during the winter and summer on a small block of ground adjoining Coyle. Some heaving and wet ground was also encountered on their property.

McGedigan & Company drifted on 60 ft. ground on Duncan Creek, a tributary of Poorman.

### Solomon Creek.

At the Big Four property on Solomon Creek 7 men were engaged in drifting in ground 80 feet deep. The gravel here also contains much ice with occasional thawed streaks. The maximum width of "pay" is from 60 to 70 feet.

Fulkinson and Mossy with 2 men were "drifting" further up the Creek in ground of similar depth but easier to mine. The gravel is free of ice streaks and is solidly frozen. The pay channel is 25 ft. wide, and is said to carry \$3.00 to the square foot.

### Flat Creek.

Wm. Midgley, Morton and McDonald, Willeky, Ferry and Cannon, Gilman and McKelvey, Powers and Bailey were drift-mining and prospecting in a small way on Flat Creek.

On Tamarack Creek, Bettles and Pilke were conducting profitable drifting operations. On Long Creek, Chas. Walker with 4 men was "sniping" a corner of ground, using a No. 3½ Keystone drill as a hoisting and steam plant. B. J. Bowers and 3 men were ground-sluicing and shovelling-in on Greenstone Creek, and small open cut mining was conducted on Bear Pup, Swift, Trail, Nowitna and Ruby Creeks.

### KOYUKUK DISTRICT

There are about 75 men in and around Nolan, which is the principal camp of the Koyukuk district. While there is still a little drift mining going on in the district, attention is now centered principally upon bench deposits. The mining of such deposits is handicapped, however, by lack of water at sufficient elevation. Most of the operations are small, many of them being conducted by partnerships of two or three men.

The district is one of high costs. Freight is brought up the Koyukuk River from the mouth to Bettles in from 6 to 7 days by small boats at a cost of 4 cents per pound. At Bettles it is transferred to shallow, horse-drawn, or poling, boats and taken to Nolan, a distance of 70 miles, at a cost of from 6 to 7 cents per pound.

Wages are \$6.00 per 8-hour day and board, which costs from \$3.50 to \$4.00 per day. Wood costs \$16.00 to \$17.00 per cord at Nolan.

Most of the operations in the district are on Nolan Creek. Seven small outfits were open-cutting the bench deposits, which are reported to be extensive. Good pay was found on the third tier bench. What little drift mining was done was mostly of a "sniping" nature.

Workman, Dow, Foley and Wool, and Wanamaker, all of whom were sluicing on the left-limit benches, report a successful season.

Watts and Brady, and Pingel and Ness mined on the Hammon River benches. Jensen and Larsen mined on Wild Creek; Matthews, with several men, ground-sluiced and shovelled-in shallow creek ground on Rye Creek.

There was very little mining on Emma, Porcupine and Slate Creeks, or in the Hog River section. Gilbert and Ellington, on Jim Pup, report good "pay," and James Kelly was mining on Bettles River.

A report was received during the summer that Ben Sirr has discovered coarse gold on the benches on Sixty Mile Creek about 60 miles up John River.

### CHANDALAR DISTRICT

The Chandalar district, which lies north of the Yukon River and east of the Koyukuk district, is one of the most isolated of the placer camps of Alaska. From Beaver on the Yukon, it is 75 miles to Caro, the main settlement of the district. It is 40 miles from Caro to Little Squaw Creek, where most of the mining is being done. Freight into the district from Beaver is practically all done during the winter by dog team. The rate for such haulage is 15 cents per pound to Little Squaw Creek. Cost of wood and timber is excessive, as it is obtained at a distance of from 12 to 40 miles from the camps. Last winter the cost of wood at camp was from \$40.00 to \$50.00 per cord.

Prevailing wages for labor are \$6.00 per day and board. Cost of boarding men is reported to be \$4.00 per day per man.

Winter drift-mining has produced most of the gold during the past season. The largest and most successful operator was Curley Smith, who worked on Little Squaw Creek, where he employed about 15 men "drifting" bench ground. It is reported that about 20,000 square feet of bedrock was mined, from which a big "clean-up" was made. An interesting feature regarding this bench ground (which varies from 30 to 70 ft. in depth) is that during the summer it is wet, and, as the creeks lower in the fall it drains and can then be mined during the winter.

Several other parties were prospecting on Little Squaw Creek.

Two outfits were "shovelling-in" in shallow ground and others were prospecting on Big Squaw Creek. A little mining and prospecting was also done on Tobin Creek.

### IDITAROD DISTRICT

Early reports as to the placer gold production from the Iditarod district in 1922 indicate an increase over the preceding year. It is estimated the output will have a value of about \$450,000. Most of this gold came from Otter, Flat and Willow Creeks. The two dredges that were operated on Otter Creek produced a large portion of this gold. Most of the placer operators in the district report a successful season. Hydraulic operations, which in average seasons suffer from lack of water, were greatly aided by the prolonged heavy rains.

The Iditarod district receives its freight via Holy Cross on the Yukon River, and, while most of it has heretofore been brought up the Yukon, several small privately owned river steamers now maintain a service from Nenana on the Government Railroad direct to the district. From Holy Cross, the route is up the Innoko and Iditarod Rivers to Dykeman and, during periods of high water, to Iditarod. Freight rates from Holy Cross to Dykeman are \$40.00 to \$45.00 per ton. From Dykeman to Iditarod the rate is \$18.00 per ton. (See Table 3). The scale of wages in the district for open cut work is \$6.00 to \$7.00 and board, for a 10-hour day. The cost of board averages \$3.00 per day. Wood costs, on the average, \$20.00 per cord. Lumber at the Dykeman sawmill sells for \$100 per thousand.

#### Otter Creek.

The Riley Investment Company operated its dredge on Otter Creek from May 20th until some time in November. A very successful season is reported. About 30 men were employed.

The Beaton-Donnelly dredge operated all season. It was being worked downstream toward ground owned by the dredge operators, on lower Flat Creek. This ground will probably be dredged next season. Though working downstream, a creditable gold recovery has been made. About 15 men were employed on and about the dredge.

On Granite Creek, the Finn boys were hydraulicking creek gravels. Three men were ground-sluicing on the Malamute Pup, and at the mouth of Glenn Gulch the Richardson Bros. with 2 men were ground-sluicing shal-

low creek gravels. A small hydraulic plant is being installed at this locality. Four men have been ground-sluicing on the Pack Mule Association. Flat Creek.

D. Strandberg with a crew of about 20 men operated a steam scraper plant on the bench at the head of Flat Creek and on the Upgrade claim he conducted hydraulic operations with a crew of about 30 men.

Thomas, Myrtle and Johnson are installing a hydraulic plant and will be ready to operate in the spring.

Hydraulic operations were conducted on the Summit Claim, where the water is stored in small reservoirs and is supplied intermittently. Ground worked here this year is reported to have been 8 feet deep and to have averaged \$1.50 to the square foot.

Pete Givovich with 6 men conducted hydraulic elevator operations in ground averaging 20 feet in depth.

#### Chicken Creek.

Mathison Bros. with 6 men hydraulicked with intermittent water supply at the head of Chicken Creek, which flows into Bonanza Creek. A very good clean-up is reported. The ground is rich but the water supply is very limited.

#### Willow Creek.

Hanley and Olson with 10 men conducted winter drifting operations in ground 24 feet deep and continued operations through the summer. The French boys, employing about 20 men, operated three hydraulic elevator plants on ground 8 ft. to 10 ft. in depth. While a fair supply of water is available at their properties, all three plants cannot be successfully worked at the same time. Loranger & Company operated their steam scraper plant. Harry Johnson and Meutcher Bros., with 7 men, operated their drag line excavator on Willow Bench. This Bucyrus excavator has a 60-foot boom with a 1½ cubic yard bucket. The 60 H. P. boiler burns about 1½ cords of wood per day. The wood costs \$16.00 per cord. The ground worked is from 22 feet to 24 feet in depth, of which about 18 feet is muck. This muck is ground-sluiced off; the gravel is dug by excavator and dumped into a movable hopper that runs on a track and dumps into the boxes. It is reported that ground running as low as 16 cents per square foot will pay expenses, and that 100,000 square feet of ground has been removed by the excavator in six weeks time.

### KUSKOKWIM DISTRICT

The placer gold production for 1922 in the Kuskokwim district will show an increase over the preceding year, and is estimated to have a value of about \$550,000. The increase in production over that of the previous years is due to the very successful season enjoyed in the operation of the Candle Creek dredge rather than to the fact that additional dredges have been erected in the district. Numerous small open cut mines and a

few small drift mines are being operated on many scattered creeks in the district, but prospecting and mining is handicapped by high costs. Wages are \$6.00 to \$7.00 and board per 10-hour day. The average cost of board is \$3.00 per day per man.

The lower Kuskokwim has experienced a quiet season. A little sluicing was done on Bear, Mabel and Canyon Creeks. The hydraulic plant of the Tuluksak Mining Company on Spruce Creek, a tributary to Bear Creek, is reported to have operated with a crew of 5 or 6 men. Further drilling is reported to have been done on the Tuluksak River.

In the Georgetown section, a new hydraulic plant has been installed on Crooked Creek by Al. Walsh and will start operations in the spring. Harry Stevens, with several men, has been ground-sluicing on a tributary of Crooked Creek and some drift-mining was done. A little sluicing was done on the Holitna, although most of the work was of a prospecting nature.

In the upper Kuskokwim, a few men were conducting small open-cut and drift operations on Ruby Creek. Prospecting was also conducted on the Tatalina River. The Kuskokwim Dredging Company operated its dredge on Candle Creek for 128 days out of a total available time of 145 days. 164,230 cubic yards were dredged, and the gold production is estimated at about \$435,000. The ground dredged averaged 14.2 feet in depth. Floods handicapped the operations.

### INNOKO DISTRICT

Increased attention was given to dredging in the Innoko District in 1922, although several small hydraulic plants were operated during the season on Little Creek. Several open cuts and a number of small winter drift mines were worked on Ophir Creek.

The Flume Dredge Company operated successfully on Yankee Creek. This company started its first season's dredging operations in 1921. The dredge is digging ground averaging 12 feet in depth. There is about 2 feet of overburden, which is ground-sluiced off. By keeping the ground stripped well ahead, the gravel thus exposed becomes thawed. The machinery and material for the Little Creek dredge, owned by the same company, has been hauled by tractor from Tacotna, and the dredge will be ready to start operations in the spring. The company will install a 300 H. P. hydro-electric plant on the Innoko River for the operation of these dredges.

The Innoko Dredging Company shipped the machinery of the old Greenstone dredge from Ruby this summer, via St. Michael. The dredge has been landed at McGrath, and is being hauled to the property to be dredged on Gaines Creek. It is reported that this dredge will be ready for operation early in the coming season.

### MARSHALL (WADE HAMPTON) DISTRICT

Placer operations were conducted on a small scale in the Marshall or Wade Hampton district, on Willow, Disappointment, Elephant, Buster



and Stuyak Creeks. The main operations were on Willow Creek, about 12 miles from Marshall or Fortuna Ledge. A hydraulic plant employing 4 to 6 men was operated and five outfits, employing a total of about 25 men, were ground-sluicing and shovelling-in. Local interests have been drilling and sinking shafts on Lower Willow Creek for the past few years and plan to install a hydraulic plant.

On Disappointment Creek, 5 men were engaged at a hydraulic operation, and one man was hydraulicking on Elephant Creek.

On Buster Creek, near Russian Mission, it is reported five men were shovelling-in, and on Stuyak Creek, which enters the Yukon about 8 miles above Russian Mission, seven men were shovelling-in.

### SEWARD PENINSULA

Within a period of 25 years ending in 1921, Seward Peninsula has produced gold which, together with the silver recovered as a by-product, has an estimated value of \$82,400,000. In 1921, the production was valued at \$1,462,000. During that year a total of 126 placer mines employing about 622 men were operated during the summer. During the previous winter 14 mines were worked, employing 64 men. Included in these operations were 16 dredges, employing 182 men. These dredges dug 1,690,000 cu. yds. of gravel, yielding about \$690,000, or 47.2% of the total gold production for that year.\*

Early reports indicate that the production for 1922 was about \$1,250,000. While this amount represents a decrease as compared with the previous year, it is a creditable output considering the unusual cold, rainy, backward season that greatly delayed the start of placer operations throughout the Peninsula. Commencement of summer placer operations on Seward Peninsula await the arrival at Nome of the first boat from Seattle. This year the date of such arrival was June 14th. At that time there had been but little thawing of the ground. No appreciable water supply was available until the latter part of June. Most of the hydraulic operations did not get under way until early in July. Dredging operations were greatly handicapped by the delayed natural thawing of the gravels. Later in the season floods caused considerable trouble and delay in some localities. Very little drift mining was done. Most of the gold production came from the Nome and Council Districts. It is estimated that over 65% of the gold output was produced by dredges and by large hydraulic elevator plants conducted at Little Creek near Nome.

As a result of the success attending the thawing of frozen gravels by the cold water method, a new field has been opened to gold dredging on Seward Peninsula. This fact is evidenced by the recent important activities of the Hammon Consolidated Goldfields Company. This company has acquired the holdings of the Pioneer Mining Company and is now having constructed at Little Creek the two largest dredges in Alaska. An electric

\*—The Alaska Mining Industry in 1921. By A. H. Brooks. U. S. Geological Survey Bulletin 739-A.

power plant equipped with Diesel engines is being erected at Nome to supply the necessary power. The total cost of the enterprise is said to be about \$1,250,000. All construction work on the project is being done by the Yuba Manufacturing Company. The dredge hulls and housing have been completed, and the machinery is being installed this winter. It is expected that everything will be in readiness to start dredging operations by June, 1923. The dredges will have 9 cu. ft. buckets on a close-connected line and it is estimated each dredge will dig from 6000 to 7500 cu. yds. per 24-hour day, or about 200,000 cu. yds. per month. The hull, trusses, and gaunties are of steel; the bottoms, sides and decks are of wood. This type of construction is considered superior to all-steel construction for northern conditions. One dredge is designed to dig 40 feet, the other 60 feet, below water level. The revolving screens are 7 feet in diameter and 40 feet long, with 1½-inch holes in the nugget section. The screen openings are ½ to ¾-inch tapered holes. One stacker is 160 ft. long, the other 142 ft. The stacker belt is 36 inches wide. The gold-table area is 4000 sq. ft. Five pumps will supply 12,000 gals. of water per minute. The main drive for the bucket line is equipped with a 250 H. P. motor. The pump motors are of 150 H. P. The total motor horsepower provided is 592 H. P. The power plant consists of three 525-H. P. Werkspoor full-Diesel engines directly connected to three 538 K. W. General Electric generators. Current will be generated at 2200 volts, stepped up to 11,000 volts, and transmitted 3½ miles to the dredges. The ground to be dredged contains much clay and muck and varies from 30 feet to over 70 feet in depth. Bedrock is composed largely of schist, which is easily dug. In order to bring the deeper ground within the digging depth of the dredges, the overlying muck will be removed by ground-sluicing. The dredges will be steam heated, and, by keeping the ground thawed well in advance, it is expected operations may be extended over a season of from 6 to 7 months. Several acres of ground were thawed with a 150-point cold water plant this fall and improvements in the practice were worked out. A 1500-point plant will be placed in operation early in the spring.

Another attempt to prospect for and work the erroneously reported rich gravels lying off the Nome beach was made this summer by Seattle interests. With a small 35 H. P. gasoline launch capable of traveling 6 miles per hour and containing a pump to operate a combination water jet and suction tube in which the gold saving device was enclosed, it was hoped to dredge off-shore, running to cover when a storm came up. Rough weather kept the boat within the jetty most of the time. The riches were not found and the operations were finally postponed indefinitely.

The first boat of the season, the "Victoria," arrived at the Nome roadstead on June 14th, but, due to shore ice, freight could not be discharged until about 4 days later. Ice conditions also interfered with coastwise boats so that operators were delayed in reaching their properties with supplies. Operators in the Fairhaven district were unable to reach their properties until about July 5th. There were four sailings of the "Victoria" during the season, the last sailing from Nome being October 24th. The

The effect of the shear stress of the contact on the stability of the column was investigated by the following which was calculated from the 22 models and compared

## Cost at Seattle

12. **Transposition**  $\rightarrow$   $\text{cost} = 100 + 200 = \$ 300$   $\rightarrow$   $\text{cost} = 100 + 200 = \$ 300$

## Transportation

$\log_{10} \left( \frac{1}{2} \right) = 0.69315$	$\log_{10} \left( \frac{1}{2} \right) = 0.69315$	$\log_{10} \left( \frac{1}{2} \right) = 0.69315$
$\log_{10} \left( \frac{1}{2} \right) = 0.69315$	$\log_{10} \left( \frac{1}{2} \right) = 0.69315$	$\log_{10} \left( \frac{1}{2} \right) = 0.69315$
$\log_{10} \left( \frac{1}{2} \right) = 0.69315$	$\log_{10} \left( \frac{1}{2} \right) = 0.69315$	$\log_{10} \left( \frac{1}{2} \right) = 0.69315$

	$\bar{\delta}_1$	$\bar{\delta}_2$
1. $\bar{\delta}_1 = 0.01$ $\bar{\delta}_2 = 0.01$ $\bar{\delta}_3 = 0.01$ $\bar{\delta}_4 = 0.01$ $\bar{\delta}_5 = 0.01$ $\bar{\delta}_6 = 0.01$ $\bar{\delta}_7 = 0.01$ $\bar{\delta}_8 = 0.01$ $\bar{\delta}_9 = 0.01$ $\bar{\delta}_{10} = 0.01$	79.2	2.0
2. $\bar{\delta}_1 = 0.01$ $\bar{\delta}_2 = 0.01$ $\bar{\delta}_3 = 0.01$ $\bar{\delta}_4 = 0.01$ $\bar{\delta}_5 = 0.01$ $\bar{\delta}_6 = 0.01$ $\bar{\delta}_7 = 0.01$ $\bar{\delta}_8 = 0.01$ $\bar{\delta}_9 = 0.01$ $\bar{\delta}_{10} = 0.01$	25.0	0.0
3. $\bar{\delta}_1 = 0.01$ $\bar{\delta}_2 = 0.01$ $\bar{\delta}_3 = 0.01$ $\bar{\delta}_4 = 0.01$ $\bar{\delta}_5 = 0.01$ $\bar{\delta}_6 = 0.01$ $\bar{\delta}_7 = 0.01$ $\bar{\delta}_8 = 0.01$ $\bar{\delta}_9 = 0.01$ $\bar{\delta}_{10} = 0.01$	157.0	0.0

[illegible]

On a similar basis, distillate or fuel oil drains costs at \$1.40 to 17¢ per gal., and landed on the dock at 39¢ per gal. Overland transportation on diesel or kerosene properties entails an additional cost of from 3¢ to 15¢ per gal. and on distillate from 4¢ to 50¢ per gal. aside from any loss sustained by reason of leakage.

There were one or two springs of fresh reports to Teller and Kotzebue. Some this year.

1. The agents of the United States Customs Service, New York Southern District, advised that the following information was obtained from the New York Southern District Customs Service. Freight charges paid by the company on these exports are \$100.00 per 150 lbs. of black mulberry silk, \$175.00 per 150 lbs. of grey mulberry silk, and \$125.00 per 150 lbs. of double grey mulberry silk.

[illegible]

The above tables show that X-ray counts decay in time exponentially unless a frequency is found of random behaviour to produce a peak. There are no new photons, all have been there previously, and the decay

The Port Seward Plan is to build a narrow gauge line between Nome and Shethin, and to equip it with the improved O. G. equipment. It will be operated so as to permit the people to operate "papiobines" or small flat cars drawn by dogs for the transportation of passengers and light freight. His idea will be of great assistance to the Kotzebok operators. It will also supply a part of the much needed means of overland transportation between Nome and Kotzebok Sound and will thereby serve to lengthen the summer operating season in that district.

During the summer of 1962, the organization of an outdoor "canyoning" at Nemi was seriously considered as a means of providing quicker passage and more direct transportation over the Peninsula. The purchase of permits and such services could, so it was thought, be profitably supplied at satellite arrangements to be made for the main center.

At Noma, the price of cold per short ton was \$2000 during the winter and \$1600 in the summer. The price of common lumber was \$100.00 per M, and that of sloyd box number \$150.00 per M.

There was no supply of crude oil during the past winter, the only source has been the selling for \$6.00 per bbl. Case gasoline this summer was sold at \$7.65 per case and distillate at \$1.85 per case. The towns of New York, Ontario, and Yates are the only ones that had for \$1.00 per barrel.

There was no strike in the consul in 1922. Much of the labor available was considered as being below the customary standard in efficiency. Average wages were from \$5.00 to \$6.00 per day and board. The length of a shift is from 8 to 10 hours. Costs from \$2.00 to \$3.00 per day to board a man. There has been a reduction from 5 to 10 cents per hour in the wages paid in some of the groups around Nome. Foreign engineers and watchmen are paid from \$7.50 to \$9.00 per day and board.

on a 12-hour basis, and, in most cases, transportation from and to the States each season is also paid by the operator.

#### Dredging.

In 1922, 15 gold dredges were operated on the Peninsula, and, while details of these operations are still incomplete, it is estimated that about \$650,000 worth of gold was produced. One dredge was operated in the Kouragok District; six in the Nome District; three in the Solomon District, and five in the Council District. (See Table 1). About 145 men were engaged in the dredging operations. The Arctic Creek dredge operated for only 2 or 3 weeks. The Bangor dredge, at its new location on Anvil Creek, started operations in August and, in the 53 days operated, recovered over \$1,100 per day. About 85,000 cu. yds. were dredged. The Behring dredge dug downstream through old tailing all season. It has now reached its "ground" and will resume regular operations in the spring.

The largest producers on Seward Peninsula were the two dredges on Ophir Creek operated by the Wild Goose Mining Company. The No. 1 dredge of this company operated for about 115 days, which is the longest operating season reported for any of the dredges in 1922. The length of the average operating season this year was about 86 days. The season was unfavorable for dredging, because of the retarded thawing of seasonal frost. Trouble and delays from floods were also experienced by some of the dredges. The Warm Creek and Crooked Creek dredges are reported to have completed the dredging of their ground. The former may be removed to Dime Creek and the latter to the Niuluk River. Two other dredges will finish dredging operations in 1923, and in 1924 dredging on Ophir Creek will be finished. It is reported that the Kugruk dredge is being taken to the Keewalik River at Candle and is to be operated there next season. The Casadepaga dredge is being moved this winter to a new location,  $2\frac{1}{2}$  miles down-river, at Canyon Creek.

#### Dredging Costs.

From more or less incomplete data obtained from the operators of 11 dredges on the Seward Peninsula for the year 1921, an attempt has been made to estimate the cost of dredging for that year. Each operation has been separately estimated and the average dredging cost derived. Included in these estimates are figures covering the operations of 4 dredges in the Nome District, 3 in the Solomon District and 4 in the Council District, operating under greatly varying conditions. While in two cases a very small amount of ground was thawed during the season's operation, this item can be disregarded and the estimates given are for naturally thawed or unfrozen gravels.

These 11 dredges dug 1,323,500 cu. yds. at an average operating cost of 21.6c per cu. yd. Where there was superintendence or management this item has been included in the operating cost. The individual operating costs range from 15c to 38c per cu. yd. Three of the dredges referred to dug 740,000 cu. yds. Many of the dredges have been acquired by the

present owners at a nominal cost. The total capital invested in these eleven dredges and their equipment is estimated at \$590,000. They could not now be duplicated for twice this amount. In considering costs, the amortization of the invested capital must be considered. The average depreciation charge amounts to 4.64c and simple 6% interest to 2.67c per cu. yd., or a total of 7.31c per cu. yd. For individual operations this item ranges from 2c to 20c per cu. yd. The cost of land, royalty, etc., has not been considered. The number of operating days varied from 75 to 129—the average was 100 days.

It should be noted that the season of 1921, to which the above figures apply, was longer and operating conditions were more favorable than the average. Were it possible to obtain dredging costs over a period of years, the resulting figures would be materially higher than those given for 1921. The cost of power in most cases, particularly where distillate is used for its generation, is a large and serious item. The following table gives estimates that have been made of the cost of the power used in the operation of the eleven dredges above considered. Only the cost of fuel and lubricating oil and the cost of labor in attendance has been taken into consideration. On most of the distillate dredges, the engineer devotes only a portion of his time to the engines.

No. and type of Dredges	Cu. Yds. dug in Season	Total H. P.	C O S T O F P O W E R			
			Per Day	Per Cu. Yd. Dredged	Per H. P. Day	% of operating dredging cost
5 Distillate .....	309,700	320	\$441.00	\$ .142	\$1.38	48.6%
4 Semi-Diesel (24" oil) .....	475,250	342	331.50	.069	.96	33.1%
1 Diesel, electric (24" oil) .....	278,000	200	87.75	.034	.44	20.0%
1 Hydro-electric .....	2020 per day	140	50.00	.025	.36	12.9%
Total—11 dredges .....		1002	\$910.25			
Average—11 dredges.....	12,470 per day			\$0.73	\$0.908	33.8%

The average cost of distillate is 63c per gal.; of semi-Diesel oil, 36c per gal., and of Diesel oil, 30c per gal.

In the above estimate the charge of \$50.00 per day for hydro-electric power includes only the proportional ditch maintenance and labor cost. The plant considered is operated about 100 days each season, an auxiliary distillate engine being used when water supply is low.

#### Hydraulic and Other Open Cut Mines.

The largest placer mining operations conducted in Alaska are those of the Pioneer Mining Company at their hydraulic elevator plants on Little Creek. These operations were taken over this year by the Hammon Company. Four pits were operated and a total of 400,000 cu. yds. were mined. About 100 men were employed. The first elevator was started June 12th, although there was hardly enough water for it at that time. Operations continued until October 14th, the ditch remaining open until the 19th.



Other hydraulic elevator plants operated were those of Lee and Swanberg on Osborne Creek, and those of the Wild Goose Mining Company on Ophir Creek. Two were also reported as having been operated in the Kougarak District and three in the Inmachuk District. A. Cordavada and Company have acquired the old Fairhaven Ditch Company holdings in the Inmachuk District. This company, employing 22 men, operated for 59 days, and will operate on a larger scale next season. A. Rydeen on Bear Creek in the Candle Section operated a rubble elevator plant with a crew of 14 men. The Keewalik Mining Company near Candle operated a rubble elevator on the old Candle Ditch Company property, employing 18 men. The company reports its most successful season. It operated for 100 days and mined 38,000 cu. yds. of high grade ground.

Thirty-five or more hydraulic plants, some of them very small, were operated in various districts. About 12 or more plants were operated in the Nome section; 4 in the Kougarak district; 2 in the Inmachuk district; 3 in the Solomon district; 2 at Dime Creek; 3 at Candle; 1 in the Casadepaga district, and 4 at Bluff. It was an unusually good season for the hydraulic miners.

One steam scraper plant is reported to have been operated on Dime Creek by Wallace Porter.

Numerous small ground-sluicing and shovelling-in operations were conducted in the various districts, although the amount of gold produced by this form of mining was very limited. A few men were also engaged in mining on the Nome and Bluff beaches, where the adept still make good wages.

#### Drift Mining.

Owing to the high cost of fuel and timber, only a very small amount of drift mining was done on Seward Peninsula in 1922. Practically all the drifting done was confined to the winter season. The largest drifting operations were those of Mebes & Company on the Submarine beach west of Nome, where about 25 men were employed and about 6,000 cu. yds. of gravel was mined during the winter.

Five or six small outfits did some "sniping" at the head of Dexter Creek, on the "Third Beach Line" and on Anvil Creek. A small number of similar operations were conducted in other sections. Most of the drifting was done at Dime Creek in the Koyuk District, where wood is obtainable. As a whole, the above operations are reported as not having been very successful, and several of the Dime Creek operations were flooded out. Early reports state that an increased number of drifting operations are being carried on around Nome this winter.

Drifting is still being conducted under the lava capping in the Inmachuk district. Good indications have been found in these buried gravels, although no "pay" has as yet been reported.

## REVIEW OF LODGE MINING BY DISTRICTS

### SOUTHEASTERN ALASKA

#### HYDER DISTRICT

The Hyder mining district, which adjoins the western border of the Salmon River district of British Columbia, at the head of Portland Canal, has attracted increasing attention throughout the past year and, in many respects, has been the most active of the new mining camps of Alaska. Numerous transfers of title to mining claims have recently been made through which several properties are now held by companies stronger financially and therefore better able to prosecute effective development work than the original individual holders.

The prosperity of the Hyder region is reflected in the improved transportation facilities recently made available. During the year just closed a dock, capable of accommodating ocean-going steamers, was built at the American town of Hyder, which is now a regular port of call on the northbound trips of the steamer Jefferson, plying between Seattle and Southeastern Alaska. This arrangement enables mining operators and others to ship equipment and supplies direct from the States to Hyder and deliver them to any point within the district without the necessity of passing customs inspection. Heretofore the necessity has existed of either landing all materials in Canadian territory or of billing them to Ketchikan and then trans-shipping them by gasboat to the small-boat landing at Hyder. Unloading facilities were very poor there and the landing was approachable only by shallow-draft lightering craft operated during periods of high tide.

The town of Hyder is the supply point for all the mining district. Several hotels, a bank and a number of general merchandise stores afford facilities for outfitting and securing supplies locally. The town is also provided with a lumber mill and with livery stables, where arrangements for freighting to outlying points may be made. A wagon road maintained by the U. S. Bureau of Public Roads extends from Hyder up the valley of Salmon River, a distance of thirteen miles to the Canadian boundary. Practically all mining properties within the Hyder District are reached by short trails leading from this road and several are almost immediately adjacent to the road.

For a description of the geographic and geologic features of the region and those of individual mining properties reference is made to "Ore Deposits of the Salmon River District, Portland Canal Region, Alaska," by Lewis G. Westgate, contained in U. S. Geological Survey Bulletin 722, Mineral Resources of Alaska, 1920. This description is accompanied by a geologic sketch map of the district and list of reports that have been published relating both to the Alaskan and Canadian sections of the Portland Canal region. An interesting description of the region and of conditions existing in the fall of 1922 has been given by Mr. Geo. J. Young in the

Pacific Mining News of the Engineering and Mining Journal Press, Vol. 1, No. 8, and Vol. 2, No. 1, December, 1922, and January, 1923, issues, respectively. Mr. Young's account includes much historical data and a reproduction of the topographic sketch map of the region, published by the British Columbia Bureau of Mines.

#### Fish Creek Mining Company.

The property of the Fish Creek Mining Company was operated throughout the year 1922, with an average of 9 men employed, and about 600 feet of underground development work was completed. Most of the work done during the year was confined to the Olympia Extension Vein, initial development of which was done during 1921. A description of this work is given in our report for the year 1921 following a visit to the property in November of that year. At that time a crosscut tunnel 140 feet in length had just cut the vein at a depth of approximately 50 feet from the outcrop. Subsequently a drift 100 feet in length was run on the vein in a southeasterly direction, a shallow winze was sunk, and some stoping was done above the drift. Following the completion of this drift a new camp, consisting of a bunkhouse, a mess house and a blacksmith shop, was erected on the Single Rose claims just east of Skookum Creek on the opposite side of the ridge upon which the old camp was situated and across the summit of which the outcrop of the Olympia-Extension vein extends. With this new camp as a base a drift tunnel 100 feet in length was driven northwesterly upon the vein at an elevation of 2675 feet. There was also started on the outcrop another tunnel, known as the "lower tunnel," 150 feet lower in elevation than that above described and just west of and 35 feet in elevation above Skookum Creek. The portal of this tunnel is on the Single Rose claim.

Surface stripping and the discovery of natural outcrops are said to indicate the continuity of the Olympia Extension vein for a distance of approximately 2,000 feet along its strike. The vein is a quartz-filled fissure. The valuable ores are argentiferous galena and tetrahedrite. During the past winter a small tonnage of ore was produced. The output was sacked and prepared for "rawhiding" to the wagon road.

The property has recently been acquired by the American Mining and Milling Company and further extensive development work has been planned.

#### Titan Group.

The Titan group of claims is situated at the head of Fish Creek and lies east of the property of the Fish Creek Mining Company and between it and the International Boundary. Operations upon it were begun in July, 1922. Since that date from 6 to 8 men have been employed, a camp has been erected, and a tunnel 150 feet in length has been driven.

At the present time the property is quite difficult of access as the pack trail from the Salmon River road extends only as far as the Fish Creek Mining Company's ground. From there to the Titan group supplies and equipment have to be packed on the backs of men.

#### Hovland Property.

The Hovland property adjoins that of the Fish Creek Mining Company on the south and consists of five claims owned by John Hovland, of Hyder. The horse trail leading from the Salmon River road to the Fish Creek Mining Company's group traverses the Hovland property from south to north and crosses the outcrop of the vein upon which most of the development work has been done. Tunnels have been driven on separate veins found on three claims of the group. These tunnels and the mineralization disclosed by them are described by Westgate in U. S. Geological Survey Bulletin No. 722, Mineral Resources of Alaska, 1920, pp. 138-139.

#### Riverside or Seven Mile Group.

Development work has proceeded actively during 1922 on the Riverside group of claims, owned by Lindeborg Brothers and situated at Seven Mile station on the Salmon River road. A crew of approximately 15 men has been steadily engaged in driving a drift tunnel on the vein. This tunnel is now 900 feet or more in length.

During the year a compressor driven by a Diesel engine was placed upon the property and machine drills have been used in the tunnel work. The mine camp has also been improved by the erection of a two-story bunk and mess house.

The work above described followed the bonding of the property to H. C. Strong, of Ketchikan, who is now in control of the mining operations.

#### The Daly-Alaska Group.

The Daly-Alaska property, situated just south of Eleven Mile station on the Salmon River road, has formerly been referred to as the New Alaska group.

In 1921 the property was bonded to Mr. Pat Daly and associates, who formed a company called the Daly-Alaska Mines. This company proceeded with development work upon the claims throughout the year 1922, the expenditures involved amounting to approximately \$30,000.00. Recent press reports indicate that the property has again changed hands and that work upon it will be continued upon an enlarged scale and with much additional equipment.

#### Stoner Group.

The Stoner group of claims lies between the Daly-Alaska group and the International Boundary. A small amount of development work was done on the property during the past year.

#### Alaska Premier Property.

Development work has progressed during 1922 on the Alaska Premier group, which adjoins the Daly-Alaska and Stoner groups and is owned by the Alaska Premier Mining Co., Alaska Building, Seattle, Wash.

## PRINCE OF WALES ISLAND

Mining on Prince of Wales Island in 1922 was on about the same scale as during the previous year, when production was limited to the output of one small copper mine. The present advanced price of copper should offer encouragement for further development work on several properties that have been idle since the close of the War.

## Rush and Brown Mine.

The Rush and Brown copper mine at the head of Kasaan Bay, on the east coast of Prince of Wales Island, has been a steady producer for many years and made about its usual output in 1922. The property is operated by Mr. U. S. Rush.

Considering the handicaps under which operators of small copper mines in Alaska have labored for many years, the Rush and Brown mine has made an admirable record. Active operations have been continued throughout the period of depression and high costs following the War. This fact is evidence of praiseworthy economy, determination and faith.

## Salt Chuck Mine.

The copper-platinum-palladium property known as the Salt Chuck Mine is now owned by the Platinum-Palladium Producing Corporation of Seattle, Wash. Financial entanglements and reduced market value of the minerals produced caused a suspension of operations at this property in 1920. It has remained idle since that time. The ore deposits of the Salt Chuck property are of an interesting type. A detailed description of them is given by J. B. Mertie, Jr., in "Mining in the Juneau and Ketchikan Districts," published by the U. S. Geological Survey in Mineral Resources of Alaska, 1919, pp. 121-127.

## Kassan Gold Mine.

The property now called the Kassan Gold Mine has hitherto been variously referred to as the Dunton, Julia and Harris Creek mine. It is situated on the north side of Harris Creek about a mile from the point where that stream enters the head of Twelve Mile Arm. The property is now held by the Kassan Gold Co., of 510 Andrus Building, Minneapolis, Minn.

Mining operations conducted during 1921 were described in the report of the Mine Inspector for that year.

An output of 426 tons of ore is reported for the year 1922. During the year drifts and levels were extended an aggregate of 180 feet. From 3 to 4 men were employed underground and from 5 to 6 men on the surface.

The ore is chiefly valuable for its gold content, though some silver is also recovered.

Writing of the region in which the Kassan mine is situated, Chapin says: (a) "South of Karta Bay and northwest of Twelve Mile Arm, including the vicinity of Hollis, is a mineralized area in which gold lodes predominate. The country rock is a complex assemblage of igneous and sedimentary rocks. The bedded rocks include tuff, breccia, schist, limestone, black slate, argillite, and graywacke, and are cut by a large boss of quartz diorite and associated porphyritic dikes. The lodes are quartz veins that occur in the intrusive and the bedded volcanic rocks as well as in the sediments.

"A number of lodes have been opened in this gold quartz belt and several small plants installed, but none has made a large production. This strongly mineralized region has never received the attention which it has deserved, and no doubt will be developed in the future. One large company might consolidate a number of these small properties and operate them to advantage."

## Moonshine Property.

The Moonshine property is located west of the South Arm of Chalmondeley Sound on the east coast of Prince of Wales Island.

After a long period of idleness, development work was resumed upon it during 1921 and has been continued steadily since that time by the Chomley Mining Company of Ketchikan.

A description of the work done in 1921 is contained in the report of the Mine Inspector for that year—p. 38.

During 1922 an average of 4 men were employed underground and 3 men on the surface. The amount of development work done totalled 1,150 feet, of which 1,050 feet were in tunneling and 100 feet in raising.

A statement by the manager of the Company, Mr. N. S. Sweetser, formerly in charge of the It and Mamie mines of the Granby Consolidated Mining Company at Kasaan Bay, says that at the Moonshine property "Silver lead ore occurs in lenses along a fissured zone in limestone. Sorted ore averages 60% lead and runs 40 oz. of silver per ton.

"The ore has been proven for a distance of 75 feet down the shaft, which is at an elevation of 3,000 feet. A tunnel 1,050 feet in length has been driven at an elevation of 2,650 feet and has intersected the fissure. A raise has been started on the fissure and will be driven to connect with the bottom of the shaft.

"An aerial tramway, 6,000 feet in length, has been built and connects the workings with the beach.

"Shipments of ore will start in the spring of 1923."

## Jumbo Mine.

The Jumbo Mine, also referred to as the Sulzer Property, situated near the head of Ketta Inlet on the west coast of Prince of Wales Island, has been idle since 1919. There recently took place a reorganization of

(a)—Chapin, Theodore—Mining Developments in the Ketchikan District, U. S. Geol. Sur. Bull. 692, p. 87.

the company which controls this property. It is now held by the Jumbo Copper Mines, Inc., 115 Broadway, New York.

No operations were conducted during 1922.

#### Shakan Molybdenite Lode.

The Alaska Treadwell Gold Mining Company owns a molybdenite property at Shakan, near the northwest end of Prince of Wales Island.

Assessment work only has been done for several years past and the property is now being carried to patent.

#### Vermont Marble Company Quarries.

The report of the Collector of Customs for the year 1922 indicates that 4,995 tons of marble valued at \$152,046.00 were shipped to the States from Alaska during the past year. This is more than double the amount exported in 1921. This output was derived from the quarries of the Vermont Marble Company at and near Tokeen on the northwest coast of Prince of Wales Island. These quarries supply much of the marble used on the Pacific Coast of the United States.

A complete description of the marble deposits of the Territory is given in "Marble Resources of Southeastern Alaska," by E. F. Burchard, U. S. Geological Survey Bulletin 682.

### CLEVELAND PENINSULA

Mining operations have been conducted on a small scale intermittently over a period of years on several properties on Cleveland Peninsula in the vicinity of Helm Bay, north of the junction of Behm Canal with Clarence Strait above Ketchikan.

Prospecting work was continued on one or two properties during 1922, but the activity was less than in 1921.

### WRANGELL DISTRICT

The Wrangell district embraces a narrow strip of the mainland and the outlying islands from Cleveland Peninsula on the south to Farragut and Thomas Bays, north of Petersburg.

The geology of the district has recently been described by A. F. Buddington in U. S. Geological Survey Bulletin 739-B, issued in 1922. This bulletin contains a geologic map of most of the district, which also shows the location of mining properties within it.

A wide variety of metallic minerals have been found within the district, including zinc, lead, silver, gold, and copper. Mining on a commercial scale has not as yet been successfully undertaken on any property within the district.

Non-metallic minerals, including barite, garnet, marble and graphite are also found in various sections of the district.

Of these only garnet has been mined.

### CHICHAGOF ISLAND

The zones within which productive ore bodies have been found on Chichagof Island lie within a belt from 5 to 15 miles wide, extending along the entire west coast of the island.

Gold is the predominant metal in the ores found within this belt and such ore bodies as have proven mineable are characterized by local occurrences of unusually high grade material.

The productive gold lodes of the coastal or western section of the zone are found accompanying shear zones in graywacke. Those of the inner section are found as quartz filled fissures within the body of an extensive mass of diorite. Other gold lodes of the western section are found within a belt of metamorphic rocks that lie adjacent to the graywacke series that occupies the coast line and near the contact.

In addition to the gold lodes, copper and nickel deposits are found in both divisions of the western section. These deposits appear to lie in the general vicinity of local occurrences of basic rocks.

For a full description of the geology of the region, accompanied by a geologic map, reference is made to "Geology and Mineral Resources of the West Coast of Chichagof Island," by R. M. Overbeck, U. S. Geological Survey Bulletin 692, Mineral Resources of Alaska, 1917, pp. 91-141.

#### Chichagoff Mine.

The tonnage produced by the Chichagoff mine during 1922 was about 13% in excess of the output for 1921.

Development work proceeded on approximately the same scale as during the previous year.

An average of 186 men were employed in 1922, of whom 93 were engaged in underground work, 65 on the surface and 28 at the mills.

#### Hirst-Chichagof Mine.

Operations at the Hirst-Chichagof mine in 1922 were continued throughout the year.

The erection of the ten-stamp mill was completed and milling operations were conducted during 260 days of the year. Underground operations were confined to stoping and the retimbering of old workings.

No new underground development work was undertaken. The production amounted to 2,700 tons of ore.

An average of 10 men were employed underground; one at the mill, and five on surface work, which consisted mostly of new construction.

#### Falcon Mining Company.

The claims of the Falcon Mining Company are at the head of Ford Arm, about twelve miles southeast of Chichagof. Development of these claims has been in progress several years past and was continued during 1922.

An average of about 15 men were employed up to October, at which time an accident to the engine that furnishes power for the compressor

occasioned a shutdown. The property has been idle since that time, though an official of the company states work will be resumed in May, 1923.

During 1922 the tunnel that has been under construction for the past three years was extended a distance of 900 feet. This tunnel is a crosscut designed to intersect veins outcropping on the surface. Its total length now exceeds 2,200 feet.

#### Brown Bear Group.

The Brown Bear group is the property of Cox Brothers of Chichagof. The claims lie between the head of Deep Bay and Didrickson Bay, which are indentations on the east side of Portlock Harbor, and approximately 6 miles in an air line northwest of the Chichagoff mine.

Preliminary development work was begun in 1921 when a permanent camp was established and the outcrop of the vein was exposed for several hundred feet along its strike.

Work was continued throughout 1922. A crosscut tunnel was driven intersecting the vein at approximately 60 feet below the outcrop. This tunnel is now 140 feet in length. Open cut work was also continued, an aggregate of 60 feet being completed.

The Brown Bear vein is a quartz filled fissure in graywacke. The quartz averages 2 feet in width where exposed at the outcrops. The vein strikes N. 30° W. It is said to carry free gold, some specimens yielding high assays.

#### Golden Copper Group.

The Golden Copper group lies at the head of Pinta Bay, about 20 miles north of Chichagof and at the northern extremity of Portlock Harbor. This group consists of six claims now controlled by the Pinta Bay Mining Company of Chichagof.

Development work was prosecuted during 1922 on this and other properties owned by the same company in the vicinity of Pinta Bay. An average of 16 men were employed. The completion of 140 feet of open cut work and crosscut tunneling is reported by the company.

The principal ore found on the Golden Copper property is chalcopryite. A description of the mineralization is given in U. S. Geological Survey Bulletin 692, Mineral Resources of Alaska, 1917, pp. 121-122.

Three other claims held by the Pinta Bay Mining Company are reported by them to show deposits of free-milling gold ore. Some work was done upon them during 1922 and further development is planned for the coming year.

#### Apex Group.

Very little work was done in 1922 on the Apex group, which adjoins the El Nido group on the west.

Following the discovery of the Apex vein and until the fall of 1921 the Apex group was held under option by the Chichagoff Mining Co., who carried on an active program of development work.

Under their tenure of the option a drift tunnel 30 feet in length, known as the upper tunnel, was driven on the vein at a point where the outcrop yielded high assays.

As a result of the very encouraging showing in this tunnel and at the outcrop a crosscut adit was driven at an elevation approximately 400 feet lower than the 30-foot drift. This crosscut was driven a total distance of about 1,400 feet. At the time the crosscut had attained that length the option held by the Chichagoff Mining Company was released and the property reverted to the owners, J. H. Cann and associates.

Work was suspended for a number of months. Later the upper drift tunnel was extended 110 feet, making a total of 140 feet. In this drift the vein is said to maintain an average width of about 3 feet. An attempt was also made to extend the crosscut tunnel in a further effort to intersect the vein at that horizon. One round was blasted and further work was found to be impossible on account of foul air and lack of ventilating equipment.

The Apex Mining Company plans to place a 5-stamp mill on the property and resume development work in 1923.

#### El Nido Group.

Good progress was made during 1922 in the development of the El Nido group of claims on Lisianski Inlet.

A new crosscut tunnel, approximately 250 feet in elevation below that completed in 1921, was driven to an intersection with the vein. This crosscut is 775 feet in length. From the end of this crosscut the vein was drifted upon for a distance of 100 feet.

A raise was also driven on the vein to a height of 225 feet above the lower tunnel level.

An average of 12 men were employed on the property during the year, eight of whom worked underground on two shifts.

The erection of a 5-stamp mill during the coming year is planned by the El Nido Company.

#### Pacific Coast Gypsum Co.

The gypsum mine of the Pacific Coast Gypsum Company at Iyoukeen Cove on the east coast of Chichagof Island was operated continuously throughout 1922 with an average of 22 men employed. The tonnage produced was about the same as in 1921.

Besides stoping operations a small amount of underground development work was done.

The reduction plant of the Pacific Coast Gypsum Company is at Tacoma, Washington. There the material mined at Gypsum is prepared for the market.

This plant supplies much of the plaster and kindred materials used on the Pacific Coast.

## YAKOBI ISLAND

## Nickel Prospect.

Two groups, known respectively as the Bohemia and the Tasmania, comprising a total of 40 or more claims, have been located on Yakobi Island. This island is situated just west of the northerly portion of Chichagof Island and forms the west shore of Lisianski Inlet and of Lisianski Strait.

A tunnel 60 feet in length was driven beneath a portion of the outcrop of one of the ore bodies in 1921. No work is reported as having been done in 1922.

Samples of the ores have been submitted to the U. S. Bureau of Mines for analysis and tests, with the purpose of having the susceptibility of the ore to commercial exploitation determined.

The exposures of nickeliferous ore on Yakobi Island are of similar type to those found and developed on the West Coast of Chichagof Island. The Chichagof Island deposits are about 14 miles southeast of those on Yakobi Island. A full description of them, including a comparison of them with the nickel deposits of Sudbury, Canada, is given by R. M. Overbeck in U. S. Geological Survey Bulletin 692, Mineral Resources of Alaska, 1917, pp. 125-134.

## ADMIRALTY ISLAND

## Peckovich Mine.

Work at the Peckovich mine of the Admiralty-Alaska Gold Mining Company, situated at Funter Bay, was confined to surface development on the vein known as the Heckler Blanket.

Numerous veins on this property have been under development for several years past.

A full description of the veins, accompanied by a map of the holdings of the company, is given by J. B. Mertie, Jr., in U. S. Geological Survey Bulletin 714, Mineral Resources of Alaska, 1919, pp. 115-116.

## Alaska-Dano Mines Company.

Contract work was continued on the Winona claim of the Alaska-Dano Mines Company during a portion of the past year. Upon the completion of the contract, work at the Winona vein was temporarily suspended. The results obtained by the work done are said by the owners to be very encouraging. During the fall of 1922 a winze was sunk in a tunnel formerly driven on a vein near the beach at Funter Bay. The numerous free-gold bearing veins that occur on the Alaska-Dano property, also known as the Nowell-Otteson group, are described by J. B. Mertie, Jr., in U. S. Geological Survey Bulletin 714, Mineral Resources of Alaska, 1919, at pp. 116-118, incl.

## Williams Property.

Work has proceeded for several years on the development of a group of claims belonging to Chas. Williams and situated on the south or Hawk

Inlet side of Mt. Robert Barron, upon the north side of which are located the Nowell-Otteson and Peckovich groups.

In 1922 this work was continued with from 3 to 8 men employed.

A rough trail was built leading from the beach at the head of Hawk Inlet to the Williams No. 4 claim, a distance of  $1\frac{3}{4}$  miles. Three open cuts, 36 feet, 45 feet and 60 feet, respectively, in length, were dug to a depth of 5 feet, exposing the outcrop of a gold-bearing vein. A tunnel 36 feet in length was also driven on the vein.

A frame cabin has been constructed in the vicinity of the workings.

Development of this property on an enlarged scale is planned for the coming season.

## JUNEAU DISTRICT

## Alaska Endicott Mining and Milling Co.

Work was continued throughout the past year on the property of the Alaska Endicott Mining & Milling Company at William Henry Bay, on Lynn Canal.

The erection of a mill building was accomplished and the machinery was placed in position. Other improvements made during the year include the construction of an assay office, the installation of a steam heating plant and the wiring of the mill building for electric lighting.

The milling equipment consists of fifteen stamps and a six-cell flotation machine, together with the necessary coarse crushing machinery. It is announced by the manager of the company that a ball mill for fine grinding and a Dorr thickener will be added during the coming season, and that milling operations will start about May 1, 1923.

Underground development work during the year included the opening of two small stopes.

## BERNERS BAY

## Jualin-Berners Mining Company.

A reorganization of the Jualin-Alaska Mines Company was effected near the close of the year and a new company was formed, known as the Jualin-Berners Mining Company. This company has resumed the work of continuing the driving of the 7,000-foot adit tunnel.

This tunnel was approximately one-half completed when work upon it was suspended in 1920. A crew of 45 men is employed at the present time.

## Yankee Basin and Eagle River.

No work other than that necessary to meet annual assessment requirements, was done on properties at Yankee Basin and Eagle River during 1922.



**Peterson Mine.**

The Peterson mine at Pearl Harbor was operated during 1922. A small production was made. The property is equipped with a three-stamp mill and Wilfley table, operated by water power. The ore is secured principally from open-cut work in veins outcropping on the Pararie claim.

**GASTINEAU CHANNEL****Alaska-Juneau Mine.**

The tonnage output of the Alaska-Juneau mine on Gastineau Channel in 1922 exceeded that of 1921 by 43 percent, and amounted to 2,310,550 tons. Of this amount 1,108,559 tons was milled. The balance was rejected as tailing after coarse crushing.

The tonnage mined and trammed in 1922 amounts to approximately 32 per cent of the total output of the property since 1913, and was greater by 144 per cent than that of 1920.

The annual report of the company states that "Of the ore trammed to the mill last year (1922), 10.6 percent came from the south half of the mine and 89.4 percent came from the north half of the mine," and "Of the total tonnage milled up to the first of this year 96 percent has come from the north half and 4 per cent from the south half of the mine."

Extensive underground development work was done during the year, designed primarily to prepare the south ore body for enlarged stoping operations.

Drifts, crosscuts and raises were driven, of which the aggregate length was 5,553 feet.

The mine crew was increased in May, 1922, in order to provide for tramming operations on three shifts. Theretofore but two shifts had been engaged in underground operations.

An average of 321 men were employed during 1922. Of this number 129 were engaged in underground work; 62 on the surface; and 129 at the milling plant.

Construction work done during 1922 included remodeling operations that provide permanent offices in Juneau, and the erection of a new carpenter shop adjacent to the wharf.

**Ready Bullion Mine.**

Operations at the Ready Bullion mine of the Alaska United Company, on Douglas Island, during the past year were confined largely to hoisting ore previously broken. This mine, which was the only one of the Treadwell group not affected by the cave-in and flood of 1917, was permanently shut down December 18, 1922. The mill ceased operations two days later.

During the year the average number of men employed was as follows: Underground, 36; on surface, 7; at the mill, 20.

**Ebner Mine.**

The property of the Ebner Gold Mining Company, which adjoins that of the Alaska-Juneau Company on the northwest, remained idle throughout the year 1922, with the exception of the annual assessment work on unpatented claims of the company.

**WINDHAM BAY**

Mining development in the Windham Bay district during the past year was confined to the performance of annual assessment work on several properties, and a small amount of placer work on Shuck River.

**SNETTISHAM****Daisey Bell Mine.**

No production was reported from the Daisey Bell mine at Snettisham. This property is equipped with a five-stamp mill. A small amount of underground development work was done in the mine.

**COPPER RIVER BASIN****Kennecott Mines.**

The Kennecott group of mines, consisting of the Bonanza and Jumbo mines of the Kennecott Copper Corporation, and the Mother Lode mine of the Mother Lode Coalition Mines Company, were operated throughout 1922 on a scale approximately 22 per cent in excess of that of the previous year's operations. The Kennecott company also operated their Glacier mine during about 100 days of the year and did a small amount of development work at their Erie mine.

An average of 540 men were employed at the Kennecott mines and mill during 1922, 309 of these being employed at the mines and 231 at the milling plant and associated works. The average number employed in 1921 was 455 men.

Major improvements completed at the Kennecott mines during 1922 included additions to the power plant and mill. Two 600 H. P. McIntosh-Seymour engines of full Diesel type were installed. The capacity of the mill was increased by 6,000 tons per month by the erection of an additional unit to the existing plant.

**Green Butte Copper Company.**

The Green Butte Copper Company continued development work on its property situated on McCarthy Creek about 8 miles above the town of McCarthy.

This property lies east of the Kennecott mines and is on a continuation of the limestone-greenstone contact adjacent to which the Kennecott ore bodies are found. Work has been in progress on this group for several years and approximately 100 tons of ore have been shipped from

it to the smelter at Tacoma. In the fall of 1922 an additional 50 tons of high grade ore had been accumulated from exploratory workings and made ready for shipment. The high grade ore occurs in the form of chalcocite, bornite and covellite.

An aggregate of approximately 2,375 feet of underground work had been done upon the property at the end of the year. This work has been done upon four claims of the group, the Green Contact, the Green Ore, the Green Fissure and the Green Stone.

On the Green Contact claim four tunnels have been driven, two of which are ten feet and two thirty feet in length. Tunnel No. 4 is in limestone above the contact and exposes a shoot of chalcocite ore along a fault plane cutting the contact.

On the Green Ore claim a series of open cuts at and near the discovery point exposes a shoot of chalcocite ore. A tunnel 270 feet in length and one 534 feet have been driven on this claim, which develop considerable high grade ore along the contact. In addition to this tunnel-work there is on the Green Ore claim a crosscut 134 feet in length, a raise 90 feet high and a shaft 45 feet in depth, together with 190 feet of open cut work on the surface.

The main tunnel on the property, known as the Barrett tunnel, is on the Green Fissure claim and extends into the Green Stone claim. This tunnel is 554 feet in length and has attached workings aggregating 310 feet in length, making the total amount of underground work on the claim 864 feet in length. Several well defined fissures intersect the ore body exposed on the Green Fissure claim and good ore shoots lead off into the limestone above the contact.

The property is provided with a permanent mine camp of log buildings, an aerial tramway, and all mine tools and equipment necessary for extensive development work.

The group comprises nineteen lode claim and four mill sites.

Application is being made for patent to the ground.

#### Placer Mining.

Data concerning placer mining in the Copper River Basin during 1922 will be found elsewhere in this report in the special article on Placer Mining in Alaska by Mr. Norman L. Wimmeler of the U. S. Bureau of Mines.

### PRINCE WILLIAM SOUND

The Beatson mine of the Kennecott Copper Corporation was the only producer of copper ore in the Prince William Sound region during 1922, although development work on a small scale was done on several small copper properties in the region. A small production of gold was made from lode properties under development in the "Gold Belt" of the Valdez section.

Improvement in the copper market is causing renewed interest in the copper resources of the Prince William Sound district and there will be greater activity during the coming year in the search for and development of copper properties than has obtained since the close of the War.

#### Beatson Mine.

The operations at the Beatson Mine of the Kennecott Copper Corp., situated on Latouche Island, were materially greater in 1922 than during the previous year. The tonnage of ore mined in 1922 was approximately 63 percent greater than in 1921. Difficulty was had in securing the desired number of experienced miners and the output from the mine would have been greater had this handicap not existed.

Extensive underground development work was done during the year. The total footage of crosscuts, winzes and raises completed amounted to 7,155 feet.

An average of 171 men were employed during the year, of whom 67 worked underground, 76 on the surface and 28 at the mill.

It is authoritatively announced that the property of the Ladysmith Smelting Corporation, otherwise known as the Girdwood mine, has been purchased by the Kennecott Copper Corporation. This property adjoins the Beatson mine on the east.

#### Rua Mine.

Development work was done at the Rua copper property, on Knight's Island, by the owner, Mr. W. A. Dickey. Four men were employed and 250 feet of tunnel work was completed.

#### Big Four Property.

The property of the Big Four Mining Company is on Mineral Creek in the Valdez district. Operations in 1922 consisted of mining and milling a small tonnage of ore. Four men were employed. The mill, which is of the Gibson type, was operated 20 days during the year.

Mining and prospecting in the Mineral Creek section are handicapped by the lack of proper trails. This area is deserving of consideration in the matter of trail construction.

#### Culross Mine.

The property of the Culross Island Mining & Milling Company, on Culross Island in the Port Wells section, was being developed during 263 days of the past year. Fifteen men were employed, four of whom were working underground. New tunnel work was completed to the extent of 165 feet and 400 feet of old tunnel was enlarged and regraded.

The property was provided with a new Ingersoll-Rand compressor with a capacity of 650 cubic feet per minute and the mine was equipped with air drills.



## WILLOW CREEK DISTRICT

### GENERAL STATEMENT AS TO LOCATION, PRODUCTION, ETC.

The Willow Creek Mining District lies approximately forty miles, in an air line, northeast of Anchorage and twenty miles east of the Alaska Railway at Mile 190. It has proven to be the most important lode mining area yet discovered tributary to the Alaska Railway and ranks among the most productive of the Territory.

The ore bodies of the district are almost exclusively free-milling gold deposits of a high average tenor. Dr. A. H. Brooks, of the U. S. Geological Survey, states that up to and including 1920 "Since mining began, in 1908, the district has produced 66,053 tons of ore, from which the average value of the gold recovered has been \$27.70 per ton and the silver recovery 0.1 ounce per ton. These figures do not, however, represent the whole value of the ores, for the gold is largely free gold, recovered by rather crude milling practice."

This excellent record has been maintained and probably exceeded during the year 1922.

Complete information is not at hand as to the production for 1922, but it is known that it was at least \$275,000.00, which is more than double that for 1921.(a) This output brings the total gold production of the district to date up to approximately \$2,222,000.00. In addition to the gold production, silver to the value of approximately \$6,000.00 has been recovered during the same period.

It has been a matter of repeated comment among competent observers that the advancement of mining in the Willow Creek district has been seriously hindered by the conspicuous lack of orderly and well-planned development work and of properly considered and carefully conducted milling practice. This condition is fortunately changing for the better. Much of the development work now in progress and contemplated is in the hands of experienced operators, who are working with competent engineering advice.

During the past two years, and particularly during the past year, there has been a gratifying increase in the interest manifested in the district on the part of investors of substantial type. This has provided stimulus for accelerated activity on the part of prospectors and several new "finds" of a promising nature resulted during 1922.

The outlook for a substantial growth of mining activity in the district during the coming year is most promising.

For the first time in the history of the district there was commenced during 1922 underground development work designed to explore lodes at considerable depths. Work of this type is being conducted by at least

Brooks, A. H.—Mineral Resources of Alaska, 1920, U. S. Geol. Surv. Bulletin 722, p. 41.

(a)—See—Mining in Alaska in 1922. Advance statement by U. S. Geol. Surv., Jan. 1, 1923.

Also—The Alaskan Mining Industry in 1921 by Alfred H. Brooks, U. S. Geol. Surv. Bull. 739-A—p. 26.

two companies and is being observed with keen interest. The results obtained will have an important bearing on the future of the district.

### ACCESSIBILITY AND MINING CONDITIONS

During the open season, the period when snow does not interfere with automobile and wagon traffic, the entire district is reached by way of Wasilla, a station on the railway at Mile 160. From here to Fish-hook Inn on the Little Susitna River, a distance of 18 miles, there is a well constructed automobile road maintained by the Alaska Road Commission and suited to all types of vehicular traffic. The average grade of this road is but slightly over one percent.

Satisfactory road-house accommodations are available at both Wasilla and Fish-hook. An automobile stage meets all trains and serves to transport passengers promptly to the southerly edge of the mining district at Fish-hook.

From Fish-hook Inn roads and trails radiate to all sections of the district.

The divide between the waters that drain into Willow Creek and those tributary to Little Susitna River separates the district naturally into western and eastern sections. The western section, which embraces the drainage basins of Craigie Creek and Upper Willow Creek, is much the more inaccessible of the two. Prior to the fall of 1922 there existed no road connection between that portion of the district and the railway. During the summer of 1922 a road was built by the Alaska Road Commission connecting at a point on the Fish-hook Creek road, near the mouth of Hatcher Creek and approximately 3 miles from Fish-hook Inn, and extending up Hatcher Creek across the divide near the head of Willow Creek, down Willow Creek and terminating on the low divide separating Willow and Craigie Creeks. The present westerly terminus of this road is approximately one mile from the Lucky Shot mill of the Willow Creek Mines Company. While this road renders the western section of the Willow Creek district much more readily accessible from Fish-hook than heretofore, its usefulness is limited by the steep gradients occurring at several places and by the altitude of the summit of the pass crossed in reaching the Willow Creek drainage. This pass has an elevation of approximately 4,000 feet above sea-level and will therefore be blocked by early snows.

The necessity still exists of freighting supplies in quantity and heavy machinery into the Craigie-Willow Creek section from Houston, at Mile 179 on the railway, only by means of sleds during the winter. This necessity materially increases the cost of mining and is the determining factor that limits the scale of operations possible in the region and also the grade and consequently the tonnage of ore that can be profitably extracted.

Problems connected with accessibility and transportation are much less serious in the eastern section of the Willow Creek District. Roads

have been constructed from Fish-hook Inn to within a reasonably short distance of all mining properties on Fish-hook and Reed Creeks and on Sydney, Archangel and Fairangel Creeks, tributaries of the latter. Gradients on these roads are quite high, however, and they have not, as yet, been surfaced and otherwise perfected sufficiently to afford means of cheap transportation. Heavy haulage is still delayed until the arrival of satisfactory sledding conditions in the winter time.

A small pack train of horses operated from the terminus of the automobile road at Fish-hook Inn serves to supply the current needs of most of the small camps of the eastern section of the district throughout the year.

The timber supply for the entire Willow Creek District while plentiful and of fairly satisfactory character is unfortunately so located as to necessitate for its delivery to the mines, an up-grade haul of from seven to ten miles. The area within which mining is conducted is wholly devoid of tree growth, being well above the local timber line.

Fortunately, reliance does not have to be placed upon wood for fuel. A winter road from Fish-hook Inn to the Moose Creek section of the Matanuska coal-field renders accessible to the district the excellent coal of that region. "Double-ender" sleds are employed to transport the coal from the mines. The distance from the coal mines to Fish-hook Inn is approximately ten miles, with practically a water grade the entire distance.

Power for mining purposes is, to a large extent, supplied by the streams of the district. Owing to the shortness of the open season, however, it is necessary to provide auxiliary power for operations conducted throughout the year. Even the larger streams, such as Willow Creek and Little Susitna River, during several months of the year are frozen to such an extent as to render them useless as sources of power. During this period those continuing operations utilize gasoline engines and these have proven satisfactory.

The erection of a plant at the Moose Creek coal mines and transmission from it of electrical power to the Willow Creek district would, no doubt, solve the power problem in the event that mining development proceeds sufficiently to warrant the expenditure involved. Steps have been taken looking toward the erection of a large hydro-electric power plant on the Eklutna River. This stream enters Knik Arm near Mile 140 on the Alaska Railway. Preliminary work on the project was done and estimates as to the capacity of the stream, etc., were prepared by the Alaskan Engineering Commission at a time when they contemplated utilizing the power in connection with their railway and coal mining operations.

The project was abandoned by the Commission but has recently been taken over by citizens of Anchorage. If it is carried to completion such a plant will, no doubt, be capable of supplying power to the Willow Creek district. The utilization of power from the Eklutna project would entail the construction of a transmission line between 30 and 40 miles in length.

### MINING OPERATIONS AND DEVELOPMENT IN 1922

#### Gold Bullion Mine.

The Gold Bullion mine of the Willow Creek Mines Company was operated throughout the year. Mining operations during the year centered principally about workings reached through No. 5 tunnel. This tunnel is the most westerly of those driven on the lode. The results of development in this section of the property have been very encouraging.

A new mine camp, capable of accommodating 14 men, was constructed at the No. 5 workings.

The Gold Bullion property, located in 1907 by E. H. and W. E. Bartholf, has been producing steadily for many years. The following description of the property is given by Chapin:

"The mine is at an elevation of 4,500 feet on the divide between Craigie and Willow Creeks, and the mill is on Craigie Creek, 1,500 feet below the mine.

"The mine is developed on a single vein that follows a very persistent fissure, which strikes about S. 10° W. and dips 14° NW. The vein filling, however, is less regular and in some places pinches to a mere stringer and in others splits up into three veins. The vein is broken by three main faults, which strike from S. 10° E. to S 30° E. and dip 40°—55° NE. These faults have produced normal step faulting of small displacement."

The faults above described have not given serious trouble in mining operations, though their presence has, at times, been vexatious and has increased the cost of mining. The mine workings are in frozen ground.

The mill equipment consists of a 6x10-inch crusher; two Hallidie batteries of five 1,000-lb. stamps each; one Joshua Hendy battery of two stamps; a Dorr classifier; and a Wilfley table. Plate amalgamation is used. The tailing from the Wilfley table is treated in a cyanide plant consisting of six sand leaching vats operated on a five-day cycle. A slime vat was tried but is said to have proved unsuccessful. The capacity of the milling plant is 60 tons per day. The entire plant is operated by three men.

#### Lucky Shot Mine.

The Lucky Shot property is also operated by the Willow Creek Mines Company. It was located June 25, 1918, by Ralph Bartholf and shortly afterward acquired by the Willow Creek Mines Company.

The ore thus far recovered from the Lucky Shot vein is of high grade and the mining operations conducted during 1922 were very successful.

The mine is situated on the steep south-facing slope of the ridge separating Shorty and Craigie Creeks, north of the latter and approximately 2½ miles below the Gold Bullion mill. It is developed by two tunnels separated by a vertical interval of about 85 feet. The lower of

these tunnels, known as the Hogan tunnel, is at an elevation of approximately 3,500 feet above sea-level, and is the main working tunnel. The two tunnels aggregate about 800 feet in length, about 600 feet of which is drift on the vein. A stope about 100 feet in length has been opened above the upper tunnel and has been carried through to the surface in several places. Between the Hogan tunnel and the upper tunnel are two small stopes, one 35 feet and the other 80 feet in length.

The vein, as disclosed in the above described workings, is well defined. The gangue material consists of fractured and decomposed quartz diorite, which is the country rock in which the lode occurs. The auriferous portions of the vein accompany plate-like bodies of quartz lying for the most part approximately parallel with the lode, and varying in thickness from a few inches to several feet. The quartz bodies do not occupy uniform positions relative to the walls of the vein, appearing in some places on or near the footwall, in other places on or near the hanging wall, and in others within the body of the vein. Cross-veining between the walls was observed locally. The separating gangue material is made up of fragments that vary greatly in size, ranging from large horses to finely comminuted material and sticky gouge.

Mineralization is not confined to the quartz itself. Finely divided gangue-matter bearing a light blue tinge and locally known as "blue filling" frequently yields high assays in gold. Notable features of the mineralization of the Lucky Shot and Gold Bullion veins are the small percentage of sulphides and the absence of visible free gold in ores said to run so high as \$600.00 per ton in gold. The Gold Bullion ore is said to yield but 0.75 percent of sulphides. In its exposed portions the Lucky Shot vein exhibits uniformity of strike and of dip and persistent continuity in lateral extent.

Chapin says (a) "The Lucky Shot vein was traced across five claims by open pits and a short tunnel that was started to open the vein. It strikes N. 60° E. and dips 45° NW."

Seventeen men are employed in mining and development work, fifteen underground and two on the surface. At the time of visit, in August, all drilling was being done by hand. Later in the year a portable compressor and Ingersoll-Leyner drills were secured for use in a new cross-cut working tunnel now being driven to intersect the vein at greater depth.

Miners receive wages of \$4.50 per day and board.

During the summer of 1921 a mill equipped with a Mine and Smelter Supply Co. battery of three 500-lb. stamps was placed on the property at the north bank of Craigie Creek and at the base of the ridge below the Hogan tunnel. An aerial tramway of the Riblet type was also erected connecting the Hogan tunnel with the mill. The tramway is equipped with two buckets of 800 lbs. capacity each. Delivery of a bucket of ore from mine bin to mill bin is accomplished in 55 seconds.

(a)—Chapin, Theodore, Lode Developments in the Willow Creek District, 1919, U. S. Geol. Surv. Bull. 714, p. 202.

During 1922 an Alaska Treadwell battery of five 1,250-lb. stamps was added to the mill and the housing of the plant was completed. The stamps drop a distance of 6 inches 105 times per minute. The discharge screens are of from 30 to 40 mesh, the latter being used when high grade ore is being crushed. Concentration on a Wilfley table, placed in the mill during the fall of 1922, follows plate amalgamation. The plates are dressed twice daily. The capacity of the plant is 30 tons per day. Power is supplied by a Pelton wheel driven by water from Craigie Creek and by a 10 H. P. Fairbanks-Morse gasoline engine. A 10 H. P. generator for furnishing electric light was placed in the mill building during the past fall.

Tailing from the mill is impounded in ponds constructed along the banks of Craigie Creek.

The erection during the present year of a cyanide plant is contemplated. The tailing bears a high gold content not subject to amalgamation.

#### War Baby Property.

The War Baby property lies adjacent to and east of the Lucky Shot group. The four claims of this group were located in 1917 by Chas. Bartholf and Duke Miller. Development work was commenced in 1918. During 1919 the erection of a 10-stamp Straub mill was completed and the mine produced a small output of ore, which was milled.

In 1918 Chapin described the vein as follows. (a)

"Surface stripping has exposed a mineralized zone about 33 feet across containing four or five parallel quartz veins that strike N. 80° E. and dip 17°-62° NW. The footwall of the lode is altered granite with 9 inches of quartz. Above this through an interval of over 30 feet are three quartz veins from 1 to 5 inches thick cutting quartz diorite. The hanging wall of the lode appears to be of red-stained fissure parallel to the quartz veins and dipping steeply northwest toward the canyon wall. About 600 feet to the southwest what appears to be the same lode is exposed. At this place a lode from 3 to 4 feet thick carries a quartz vein 15 inches thick and stringers of quartz in altered granite."

During 1922 development work was being carried on by the Willow Creek Mines Company, who hold the property under option.

This work was being done by contract in the lowest of the three tunnels that have been driven on the vein, and progress was being made at the rate of about 100 feet per month. The vein was being drifted upon in a westerly direction with the plan in view of projecting the tunnel to a point beneath the workings of the adjoining Lucky Shot mine, thus establishing the relationship between the veins on the two groups. It is thought the War Baby vein may be an easterly portion of the Lucky Shot lode, although a cross-fault of some magnitude is known to intervene between the workings on the two properties.

(a)—Chapin, Theodore, Lode Developments in the Willow Creek District, 1918—U. S. Geol. Surv. Bull. 712, p. 174.

**Come-Back Group.**

The Come-Back group of claims is situated on the same ridge as are the Lucky Shot and War Baby properties and lies about three-fourths of a mile east of the latter. A tunnel 60 feet in length is said to have been driven on a vein exposed at an elevation of approximately 4,000 feet. This tunnel was not visited and details with regard to the ore exposures are lacking. Three men were at work on the group during the summer of 1922.

**Rainbow Group.**

The Rainbow group lies east of the War Baby claims. It was discovered and located by B. S. Bartholf on September 9, 1921. The claims of the group occupy a portion of the valley of Craigie Creek and the lower slopes of the hills below the Gold Bullion property. Float quartz of very high grade was found in material believed to be the overburden covering an underlying lode. This belief is said to be supported by the fact that the float is traceable along a practically straight line across the flat-lying bottom land adjacent to Craigie Creek.

The property was under option to a substantial mining concern during 1922 and much surface trenching and open cutting was done in an endeavor to locate the lode believed to be the source of the float.

**Drumlummon and Mazuma Claims.**

The Drumlummon and Mazuma claims occupy the interval between the west end of the Gold Bullion group and the east end of the Rainbow group. They were located in 1922 by J. B. Garver.

**Brassel Bros. Claims.**

Assessment work only was done on the claims of Brassel Brothers that are situated near the head of Craigie Creek about 1½ miles above the Gold Bullion Mill.

The vein on this property is described by Chapin as follows: (a)

"A large fissure vein, which is said to have been traced for six claim lengths, is 19 feet across. The walls are well defined, with 6 inches of gouge on the footwall and 18 inches on the hanging wall. The vein is composed of altered quartz diorite with stringers of quartz. It strikes N. 70° E. and dips 42° NE. About 100 feet below it is a parallel quartz-feldspar dike with some vein quartz which carries a little gold. On the Gold King No. 3 and Leona claims a number of surface workings show several small veins of rich quartz, and a tunnel is now being driven to open these veins."

**Long and Holland Prospect.**

A tunnel 50 feet in length was driven on the Long and Holland prospect during the spring and early summer of 1922. This property was not visited. Chapin describes the vein as follows:

(a)—Chapin, Theodore—Lode Developments in the Willow Creek District, 1919, U. S. Geol. Survey Bull. No. 714, p. 202.  
Op. Cit.—p. 203.

"The Little Willie claims were recently staked by Long & Holland on the divide between the heads of Craigie, Purches, and Fairangel Creeks. The principal vein crops out on Craigie Creek above Craigie Glacier and has been traced across the ridge into the head of Fairangel Creek. This vein strikes N. 77° W. and dips 26° NE. It is composed of quartz stringers from an inch to 6 inches wide which closely follow a green igneous dike made up entirely of secondary minerals, essentially sericite, quartz, and calcite. Originally this altered rock was probably granite or monzonite, composed of quartz and feldspar with some hornblende or mica. The quartz vein is evidently of later date than the dike but follows it closely along one wall or the other and in places occurs as several parallel veins within the igneous rock. The vein is small but is very persistent and from the amount of free gold in the outcrop is apparently very rich."

**Kelly Mines Company—Brooklyn Tunnel.**

Work was commenced during the summer and continued during the winter of 1922 on a tunnel situated on the Brooklyn group of claims at the head of Willow Creek. This tunnel is being driven by H. A. Kinney and associates under contract with the Kelly Mines Company, present holders of the group.

The contract calls for a tunnel 1,000 feet in length. The portal of the tunnel is situated at an elevation of about 4,000 feet above sea-level. The tunnel is designed to penetrate and explore at depth veins that outcrop on the Alaska Free-Gold property on the opposite or east side of the ridge that forms the divide between the head of Willow Creek and the valley of Fish-hook Creek.

A comfortable camp of log buildings is available for the crew engaged in this work. A new compressor house of frame construction has been erected near the portal of the tunnel. In this is housed a 16x18x8-inch Ingersoll-Rand compressor and a 15 H. P. gasoline engine for use in supplying compressed air for driving the tunnel. This equipment was formerly employed in the mining operations conducted on the property of the Alaska Free-Gold Company.

**Properties on Fish-hook Creek.**

There was very little mining activity during 1922 on properties within the drainage basin of Fish-hook Creek. However, the Brooklyn tunnel, above described, is designed to develop lodes outcropping on and heretofore worked from the Fish-hook Creek side. The properties covering these lodes have been consolidated and are now controlled by the Kelly Mines Company.

At the Gold Cord property assessment work only was done during 1922. The claims of the group were also surveyed for patent. A small production was made from the property in 1917 and 1918, but, with the exception of the performance of annual assessment work, the mine has been idle since 1918.

A description of the property may be found in U. S. Geological Survey Bulletin No. 712—Mineral Resources of Alaska, 1918.

Work was conducted during a portion of the summer of 1922 on the Rae-Wallace claims, situated on the east side of Fish-hook Creek Valley, and a small tonnage of ore was milled. Operations were discontinued early in the fall.

#### Mabel Mine.

The Mabel mine is situated on the eastward-facing slope and near the summit of the divide separating Reed Creek on the east from Sydney Creek on the west. The mine workings lie at an elevation of approximately 3,800 feet above sea-level and about 1,500 feet above the mill, which is on the gently sloping bench immediately west of Reed Creek.

In 1918 Chapin described the workings and ore bodies as follows: (a)

"The vein has been exposed on the surface for a claim length by short tunnels and open cuts. The vein strikes about north and dips west at a low angle. The mine is being developed by two parallel tunnels known as tunnels 2 and 3, driven northwestward to intersect the vein. The principal work has been done on tunnel 2, which follows a joint plane. About 20 feet from the mouth the tunnel encountered a fault striking north to northwest and dipping 45°-60° W. A drift extended northward along this fault plane exposed the quartz vein abutting against it. The portion of this vein extending from this fault to the surface has been stoped out and milled for a part of the distance between the two tunnels. At the face of tunnel 2 a short drift was turned off to the north and a much longer one to the south, following the intersection of another fault and quartz vein. Both strike about N. 30° E. and dip northwest. The quartz vein dips 30°, but the fault is much steeper and exposes the quartz vein in the northwest wall of the drift. The quartz here is as a whole of rather low grade but carries stringers of very rich ore.

"Tunnel 3 extends northwestward about parallel to tunnel 2. Near the face a flat-lying vein of quartz was cut and followed southward by a drift. The vein is about 4 feet wide but is barren. A crosscut to the east cut a small quartz vein with some very rich pockets. This vein, which is also cut off by a fault, resembles the eastern vein in tunnel 2 in character, but correlations between the veins exposed in the different workings have not been established.

"The ore is transported by an aerial tramway to a 15-ton Denver mill operated by water power. The tailings are ponded for future treatment."

Since the above was written development work has been continued from year to year but in a manner that has not resulted in the progress that should have been made.

During the summer of 1920 the milling equipment was increased by the addition to the plant of two mills, one a Straub and the other a

(a)—Chapin, Theodore—Lode Developments in the Willow Creek District, 1918, U. S. Geol. Sur. Bull. 712, pp. 175-176.

Gibson. There were thus provided three distinct types of mills within the same building, the original one being a 15-ton Denver mill. The difficulties arising from the attempted use of such a variety of equipment, in cramped quarters and with inadequate power, were inevitably such as might have been anticipated.

In spite of conditions such as above indicated, the Mabel property has been quite productive and gives promise of having a successful future. During the summer of 1922 an option upon it was obtained by Bartholf and Horning. These experienced prospectors carried forward development work and milled a small output of ore. Later in the year their option was taken over by individuals identified with the Guggenheim interests. It is understood the new holders will carry on development of the property during the coming season.

#### Talkeetna Mine.

The Talkeetna mine, formerly operated successively by the Matanuska Gold Mining Co., the Talkeetna Gold Mining Co., and W. F. Rock, has been for the past two years, and is now, controlled by the Consolidated Gold Mines Alaska, of Spokane, Wash. This company has extensive holdings in the vicinity comprising 60 or more claims. The mine is located on the steep ridge forming the north side of the valley of Fairangel Creek and is about 1 mile west of the confluence of that stream with Archangel Creek. The mine workings are at an elevation of approximately 4,300 feet above sea-level.

The mine is developed by several tunnels. The main working tunnel is somewhat over 500 feet in length and is throughout a drift on the vein. Chapin states (a) in 1919 that, "For the first 200 feet from the portal of the tunnel the vein is from 5 to 18 inches wide, but it widens abruptly and for the next 100 feet to the face of the tunnel is from 5 to 8 feet wide and in places contains 5 feet of solid quartz."

Since Chapin's visit development work in this tunnel has consisted of adding approximately 200 feet to its length, driving several crosscuts from it, and one raise, 62 feet in length. From the top of the raise a new level was driven northeasterly on the vein. Work on this upper level showed the vein to have, in places, a width of from 15 to 20 feet.

Writing of the vein in 1919, Chapin stated (a) that "The ore is banded rusty white and gray quartz, with considerable gouge. The quartz contains some visible gold, and in spots the ore is very rich, but the workable rock is confined to definite pay shoots within the vein."

John A. Davis of the U. S. Bureau of Mines, who visited the property in the fall of 1922, says "The ore is free milling and occurs in a shear zone which is undoubtedly the extension of the one in the Fern mine.

"The associated minerals are arsenopyrite, pyrite, and a small amount of antimonial galena. The gangue is quartz and decomposed granite. The shear zone is 15 to 20 feet in thickness and accompanies a fault

(a)—Chapin, Theodore—Lode Developments in the Willow Creek District, 1919, U. S. Geol. Sur. Bull. 714, p. 204.

(a)—Op. cit.—p. 204.



in the granite, the ore being found chiefly in stringers of quartz in the shear zone. The strike is N. 60° E., the dip 50° N. The richer ore is apparently found in shoots which pitch to the northeast."

During the summer of 1922 a crew of from 15 to 20 men were employed at the property, and during the fall and winter from 5 to 7 men.

The property is equipped with a comfortable camp, situated near the workings, and a mill located in the valley of Fairangel Creek, below the mine. An aerial tramway serves to convey the ore to the mill. On this tramway, at 1,500 feet from the mine, is an angle station, from which the distance to the mill is 500 feet. The milling plant contains a No. 1 Denver quartz mill with a rated capacity of 15 tons per 24 hours and is provided with two bins having a combined storage capacity of 80 tons. There is also at the milling plant a small Ingersoll-Rand compressor driven by a 15 H. P. Pelton wheel. This compressor supplies air for driving two jack-hammer drills used at the mine during the season while water-power is available. The mill is closed down in the fall when the freezeup occurs, and hand drilling is done in the mine development work during the winter.

The present manager states that the company intends placing a new Marcy rod mill in a plant to be erected during the coming summer near the confluence of Fairangel and Archangel Creeks. The company also proposes to erect a new power plant, which is to be situated on Reed Creek, preparatory to starting a lower crosscut working tunnel at a point about 250 feet in elevation below the present adit.

#### Fern Mine.

The Fern Mine, heretofore referred to as the Fern and Goodell prospect, is situated on the west side of Archangel Creek about ½ mile above its confluence with Fairangel Creek and approximately 5½ miles from Fish-hook Inn. The property is now owned by the Fern Gold Mining Co., of Spokane, Wash. The following description of the ore zone and mine workings is given by J. A. Davis of the U. S. Bureau of Mines, who visited the property in the fall of 1922:

"The ore is free milling gold ore in a gangue of quartz and gouge and carries some pyrite and arsenopyrite. It occurs in a shear zone from 7 to 10 feet in width which accompanies a well-defined fault and contains a number of small quartz stringers. These usually occur in groups, one of which is generally found near the foot wall, one near the middle of the shear zone and one near the hanging wall. The entrance to the mine is by means of a tunnel at an elevation of approximately 4,000 feet. This tunnel follows the vein close to the foot wall, which is fairly well determined but owing to the narrowness of the tunnel the hanging wall was not observed. The strike at the breast of the tunnel is N. 50 E., the dip 50 N. The country rock on both sides of the shear zone is granite. The tunnel is 3 feet wide at the top, 4 at the base and 6 feet high, and on November 18, 1922, had been driven for a distance of 465 feet.

"A six-inch Buffalo blower driven by a gasoline engine was being installed to force air to the face for ventilation through a six-inch canvas

air pipe. The muck from the tunnel is trammed to the surface by hand in 16-cubic-foot steel cars on an 18-inch gage track composed of 12-lb. rails. The native spruce used for the tunnel sets is secured in the valley of Knik Arm, 8 or 9 miles distant. The average size of the timbers is approximately 6 inches. No stopes or other levels have been driven as yet, although on November 18, 1922, a raise for a stope was being started at a point 550 feet from the portal. Carbide lamps are used for illumination. It is planned to use the "filled stope" method of mining, in which the ore will be sorted roughly under ground and the waste thrown back into the stope.

"At the time of examination the mine was producing from 15 to 20 tons of ore per day, all of which was conveyed to the mill by an aerial tramway 1,300 feet long. The two carrier cables were ⅝-inch in diameter, the pullback cable ¼-inch. The buckets hold 500 pounds and it required about 2 minutes to load them and 1¼ minutes to travel from the mine down to the mill. On this basis the capacity of the tram would be approximately four tons per hour. The mill is operating one 12-hour shift at present but it is planned to initiate two shifts later.

"The ore is treated by amalgamation, the milling equipment consisting of an eight by ten-inch Denver jaw crusher, a plunger feeder, a No. 2 Denver quartz mill and an amalgamation plate 4½x12 feet set at an 8-degree slope. The flow sheet is as follows:

1. Inclined tramway.
2. Ore bin, capacity 114 tons.
3. Jaw crusher.
4. Ore bin, capacity 25 tons.
5. Plunger feeder.
6. No. 2 Denver quartz mill crushing to 40 mesh.
7. Amalgamating plate.

The amalgam from the plate goes to a retort and the tailings go to a settling pond.

"The mill is driven by a Fairbanks-Morse, type Y. H., single cylinder oil engine rated at 25 H. P. and operating at 325 r. p. m. The value of the feed to the mill is reported at \$25 to \$30. The loss in the tailings is quite high, the sample from one run assaying over \$8 per ton."

#### Opal Prospect.

The Opal prospect, owned by Skarstad and Laubner of Anchorage, is situated on the west side of Reed Creek and about one mile above its confluence with Archangel Creek. It is easily reached by road from Fish-hook Inn.

The following description of the veins on this property is given by Chapin: (a)

(a)—Chapin, Theodore—Lode Developments in the Willow Creek District, 1919, U. S. Geol. Sur. Bull. 714, p. 205.

"Two parallel veins have been traced by surface pits for two claim lengths. The veins strike N. 50° E. and dip 50° NW. The outcrop of the upper vein is from 3 to 4 feet wide and consists of quartz and gouge along each wall, inclosing considerable altered diorite, all of which carries gold. The hanging wall is mineralized diorite with stringers of quartz and also contains gold. The lower vein is from 3 to 5 feet wide. It is made up of stringers of quartz and gouge in altered diorite and carries much pyrite from which gold may be panned after roasting. A tunnel was started in the fall, and work was continued during a part of the winter."

During 1920 and 1921 a crosscut tunnel was driven a distance of 180 feet to an intersection with the lower of the two veins described by Chapin. During 1922 drifts aggregating 100 feet in length were driven on this vein in both directions from the crosscut tunnel. The crosscut tunnel was also extended a distance of 100 feet. In addition to the above work 25 feet of open cutting was done on the surface.

#### Homebuilder Prospect.

The Homebuilder prospect is the property of Richter and Hansen, of Anchorage, and lies just northeast of the Opal group, above described.

The development work on the ground is confined largely to surface stripping and open-cutting along the outcrops of the veins. A short crosscut prospect tunnel has been driven below the outcrop of the lowest vein exposed.

During the fall of 1922 the owners were erecting a camp and placing machinery upon the ground preparatory to driving a new crosscut tunnel. This tunnel will be at an elevation of 3,200 feet above sea-level. It is estimated that the first vein of the four thus far exposed on the surface will be intersected by this crosscut at a distance of about 350 feet from the portal. The machinery on the ground consists of an Ingersoll-Rand gasoline driven air compressor with a rated capacity of 145 cu. ft. per minute and a jack-hammer drill. It is planned to operate the compressor during the summer time by means of a Pelton wheel, with water under a 600-foot head.

During the past fall a tramway 1,000 feet in length was put in place, connecting the tunnel site with the camp, which is in the valley bottom below.

Four men were employed during the winter.

#### Gold Mint Property.

The property of the Gold Mint Mining Company, locally referred to as the Hatcher property, is situated on the south side of the main valley of Little Susitna River, about 5 miles above Fish-hook Inn. It is reached by trail only, from the automobile road at Fish-hook.

Development of the Gold Mint property was commenced in 1919 by J. B. Hatcher. Chapin visited the workings that year and says of the veins: (a)

(a)—Chapin, Theodore,—"Lode Developments in the Willow Creek District, 1919—" U. S. Geol. Sur. Bull. 714, pp. 205-206.

"The country rock is gneissoid quartz diorite. Several veins intersect the property. The upper vein strikes N. 50° W. and dips 42° SW. It is composed of 10 to 17 inches of bluish-white quartz, with considerable pyrite and chalcopyrite and some visible gold. The vein has been traced for some distance on the surface and appears to be persistent. The lower vein strikes N. 30° W. and dips 62° SW. Where exposed by several surface cuts the vein consists of milky-white quartz with rusty streaks and blotches from the oxidization of pyrite. Between these two veins are two or three others that strike about north. These are apparently barren where exposed. The developments consist of a short tunnel that is being driven on the upper vein and surface pits to prospect the veins."

Since Chapin's visit approximately 800 feet of tunnels, raises and winzes have been driven on the two veins described and in addition several open cuts have been dug.

There are now 5 tunnels in the property. Tunnels Nos. 1, 3 and 4 penetrate the most westerly vein, which is that whose outcrop is at the lowest elevation. Tunnel No. 4, which is the main tunnel of the lower group, is at an elevation of 2,550 feet above sea-level. It was driven in 1921. It follows the vein for a distance of approximately 125 feet. As exposed in this tunnel the vein is of solid quartz but of irregular width, being in places but a few inches wide and expanding locally to a width of from 2 to 3 feet. Several cross-faults interrupt the continuity of the vein. These are of comparatively small magnitude but have given trouble in the development work on this vein. During 1921 a raise, 28 feet in height, was driven on an expanded portion of the vein. This encountered a cross-fault and was discontinued. During 1922 a winze was sunk a short distance in from the portal of the tunnel and a small tonnage of ore was taken from it and milled. Considerable cross-cutting and some further drifting failed to reveal a mineable tonnage of ore and during the early summer work on the development of the vein was abandoned.

Tunnel No. 2, also known as the "upper" tunnel, is at an elevation of 3,125 feet above sea-level and is several hundred feet east of the workings above described and on a separate vein. This tunnel was commenced in 1920. At the time of visit in August, 1922, it was approximately 150 feet in length and was being driven ahead. A small amount of stoping was done above the tunnel during the year and the ore produced was milled. A tram line was built connecting the portal of the tunnel with the mill. The zone within which occurs the vein upon which No. 2 tunnel has been driven has been faulted with the result that the vein filling has been broken up and rendered discontinuous. The material penetrated is fragmental, the larger pieces being separated by streaks of gouge and finely divided country rock. The tunnel requires careful timbering. The zone of fracturing is seven or more feet in width and is characterized by a reddish-brown coloration due to the presence of oxides of iron. Oxidation extends to the present limits of exploration.

Tunnel No. 5 was driven in the spring of 1922. It is situated between tunnel No. 2 and the "lower" workings and is at an elevation of 2,700



feet. It is 48 feet in length and exposes a vein of banded quartz in fine-grained dark colored diorite. The vein strikes S. 35° E. and dips 50° SW.

Between tunnels No. 2 and No. 5 and at an elevation of 2,925 feet there is exposed by a large open cut and short tunnel the outcrop of a fault of considerable magnitude. The main gouge seam of this fault strikes S. 10° W. and stands nearly vertical. Within the limits of the fault zone the finely divided diorite is altered to a light gray color and is quite extensively pyritized. Mr. Hatcher states that fragments of quartz in the fault material obtained from an open cut on the fault about 200 feet above the exposure above described yielded much free gold upon being panned.

The Gold Mint property is well equipped. A five-stamp mill and a substantial mine camp capable of comfortably accommodating twenty or more men were erected during 1921. The mill is situated just south of the Little Susitna River, and is connected by aerial tramways with the portals of No. 2 and No. 4 tunnels. Water power is used to drive the stamp-mill and also the compressor which furnishes air for the machine drills used in all underground work.

#### Other Properties In the Willow Creek District.

Besides the mining and development work above described, assessment work and prospecting were conducted on numerous groups of claims throughout the district that were not visited and details concerning which were not obtained.

The coming season will, no doubt, be one of unusual activity in the Willow Creek district as a whole.

### IDITAROD DISTRICT

Mining activity in the Iditarod district hitherto has been confined almost exclusively to placer operations, although some prospecting has been done for lode deposits and a little development work performed on outcrops discovered in several places within the district.

Renewed interest in the possibility of successful lode mining in this region was awakened during the past year by the development of an auriferous quartz vein that was discovered in the fall of 1921.

#### Golden Horn Property.

The discovery above mentioned was made by Jerome Warren and Rasmus Nielson, who have located six claims along the outcrop. The property is now held by the Golden Horn Mining Company, recently incorporated.

The discovery of the vein was made at a point on the left limit of Otter Creek, about 3 miles above Flat and near the point where the trail leading from Flat to Ophir and Tacotna crosses the stream, ½ mile above the placer camp Discovery. The group extends from the above

described point along the vein southwesterly across the slopes of Black Butte and toward the head of Flat Creek.

Mr. Warren states that the vein averages 3 feet in width and is composed of banded quartz in granite country rock. The vein is said to lie parallel with the contact of the enclosing granite with black slate and at an average distance of 300 feet from the contact.

Mr. Warren also states that the mineralization of the quartz is uniform, that is, not "pockety," and that the ore carries from 7% to 8% sulphides, the balance being free milling gold. Returns upon samples said to be representative of the average of the ore exposed by present development work indicate ore that can be profitably mined even with the high costs at present obtaining.

During 1922 extensive development work was done upon the property. A crosscut tunnel, 300 feet in length, was driven to an intersection with the vein; the vein was drifted upon for a distance of 340 feet; a winze 50 feet in depth was sunk from the drift; and a shaft was sunk from the surface a distance of 48 feet to an intersection with the drift.

At a distance of several hundred feet southwesterly from the above described workings another shaft was sunk upon the vein from the outcrop to a depth of 35 feet. At that point water was encountered and work was discontinued. Numerous open cuts and trenches were also dug along the outcrop.

During the year approximately 1,500 tons of ore are said to have been produced, of which 48 tons were shipped to the smelter at Tacoma. The existing freight rate on ore from Flat to Tacoma is \$51.00 per ton.

The property is at present equipped with a boiler, a hoist and a 700-foot steel-rail tram.

#### Thrift Quicksilver Property.

The quicksilver property of the Thrift Mining Company, situated about 20 miles southwest of Iditarod, near the head of Iditarod River, was idle during 1922.

### RUBY DISTRICT

Lode mining development in the Ruby district during the past year was limited to a small area in the Kaiyuh Mountains, about 20 miles southwest of Galena, formerly known as Loudon. Galena is a river landing and small town on the left bank of the Yukon River, approximately 50 miles below Ruby. A trail leads from this point to the mining properties.

#### Perseverance Property.

The following description of the mining properties was obtained by Mr. Norman L. Wimmeler, of the U. S. Bureau of Mines, from Mr. Trick, of Kincaid and Trick, owners of the Perseverance claim:

"The ore deposits occur in small lenses found within a fissure in light green schist. The hanging wall of this fissure is "free." A lime-

stone formation is found in the near vicinity of the present workings. There is a deep overburden. Lenses of ore are found to be small, averaging from 80 to 100 tons of high-grade galena to the lens. The width of the ore ranges from 2 inches to 36 inches. One lens averaged 16 inches in width. The ore deposit has been traced a distance of 300 feet on the Perseverance claim."

#### Farrell & O'Brien Claim.

Farrell and O'Brien have found, on an adjoining claim, a small ore showing which is thought to occur on the same fissure as that exposed on the Perseverance claim. On this claim are two shafts, 40 feet and 30 feet deep, respectively, from each of which 70 feet of drift tunnel has been driven.

There is also an adit tunnel, 50 feet in length, which is now caved.

Aitken and Price, who held the property under option in 1921, shipped from it 144 tons of ore that is said to have averaged 107 oz. in silver per ton.

In the spring of 1922 the owners of the claim shipped 50 tons of ore to the smelter at Bradley, Idaho. Returns from this shipment are said to have been 107.7 oz. silver per ton and an average of 72.15% lead. The cost of transporting the ore during the winter from the property to the Yukon River at Galena was \$30 per ton. Freight charges from Galena to Bradley, Idaho, were \$37 per ton.

## LODE MINING IN THE FAIRBANKS DISTRICT, ALASKA

By JOHN A. DAVIS

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### INTRODUCTION

The Fairbanks district comprises an area of approximately 500 square miles in the vicinity of the town of Fairbanks, which is situated on a branch of the Tanana River at Lat. 64° 51' N. and Long. 147° 53' W. Although there was a determined effort as early as 1905 to find the gold-bearing quartz veins which were believed to exist as the source of the extensive placer deposits of the district, it was not until 1908 that discoveries of any importance were made. From that time until 1915 lode mining had a rapid growth and attained a production valued at \$350,000 per year in spite of the difficulties caused by climate, by the large amount

of overburden (most of which is perpetually frozen and makes the uncovering of solid rock an arduous task), by costly and inadequate transportation on river boats able to operate but four or five months during the summer, and by lack of fuel due to the rapid exhaustion of standing timber in the more favorable districts. Beginning with 1916 the steadily mounting cost of supplies caused by war conditions was added to these other difficulties. Prospecting eventually stopped; many of the mines were forced to suspend operations and the production of gold from lode mining dropped to \$20,000 per year. In 1921, however, the Alaska (Government) Railroad was completed from Tidewater at Seward to its northern terminus at Fairbanks except for a bridge now under construction across the Tanana River, and the better shipping facilities thus afforded (despite the transfer across the Tanana) not only for supplies from the States but also for cheap fuel from the coal mines in the Nenana field, have caused a revival of lode mining which is steadily gaining headway. In view of the renewed interest thus aroused it has been deemed advisable to compile and publish at this time the information available on the subject of lode mining in the Fairbanks district.

### DRAINAGE AND TOPOGRAPHY

The Tanana River, one of the principal streams in Interior Alaska, flows west along the southern edge of the district and joins the Yukon about 225 miles below Fairbanks. The rivers next in importance within the district are the Chatanika, near the northern edge, and Goldstream, near the center, both flowing west into Tolovana River, which empties into the Tanana 80 miles above its junction with the Yukon. The eastern portion of the district is drained by tributaries of Chena River which flows through the town of Fairbanks and joins the Tanana 11 miles below. South of Fairbanks the broad, flat Tanana valley extends for 25 to 40 miles until it reaches the northern foothills of the Alaska Range. North of the town the surface rises to an upland or plateau which is intimately dissected by the alluvium-filled valleys of the larger streams and their tributaries whose walls usually rise by gentle slopes to the rounded crests of the hills, 1,500 to 2,000 feet higher than the level of the Tanana valley.

### GENERAL GEOLOGY

Throughout the Fairbanks district the greater portion of the bed-rock is formed by a variety of metamorphic rocks which have been grouped together geologically and named Birch Creek schist. In addition to various types of schists this group also includes quartzites, crystalline limestones, altered calcareous rocks, and some granitic gneiss. The rocks are closely folded, and faults are numerous. No fossils have as yet been found, hence the age is not definitely determined, but judging from structural relations it is supposed to be wholly or in large part Cambrian.

Several varieties of intrusive rocks belonging chiefly to the granite and diorite groups are associated with the schist, and are in all likelihood not only the source of the mineralization of the district, but also are

the cause of the shattering of the schist which afforded channels for the circulation of mineral-bearing solutions.

#### ACKNOWLEDGEMENTS

The writer wishes to express his appreciation of the cooperation and assistance in the preparation of this report he has received from mine owners and prospectors in the Fairbanks district, and to acknowledge his indebtedness to the several authors of the bulletins of the United States Geological Survey listed below (a); especially since it has been impossible to give credit in individual instances for information obtained from these published reports which have been freely drawn upon for data of early lode mining activity.

#### DESCRIPTION OF GOLD MINES AND PROSPECTS

There are two principal areas in the Fairbanks district where gold lode mining has been particularly active, the first centering around Pedro Dome, which lies about 18 miles northeast of Fairbanks; the second around Ester Dome, which lies 9 or 10 miles west of the town. For convenience the descriptions of the various mines will be grouped according to the creeks in whose watershed the mines are located. Near Pedro Dome these include: Fairbanks Creek, which is one of the headwaters of the Chena River; Cleary, Little Eldorado, Dome and Vault Creeks, which are tributaries of Chatanika River, and Pedro Creek, which is one of the main forks of Goldstream. In the neighborhood of Ester Dome, the mines are found chiefly in the watersheds of St. Patrick and Ester Creeks. These are headwaters of Cripple Creek, which joins Chena River a few miles below Fairbanks.

- (a)—Mineral Resources of Alaska, 1909, Alfred H. Brooks and others, Bull. U. S. Geol. Survey 442, Washington, 1910.  
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#### FAIRBANKS CREEK

##### Hiyu Group.

The Hiyu group consists of ten claims, including the Helen S., Teddy R., Hiyu and Nars, situated on the ridge between Too Much Gold and Moose Creeks, both of which are short tributaries of Fairbanks Creek. The property is two miles northwest of Meehan, the nearest postoffice, and twenty-five miles northeast of Fairbanks. The most accessible railroad station is Gilmore, on the Chatanika (narrow gauge) branch of the Alaska Railroad. It is thirteen miles by wagon road from the property. The owners and operators of the mine are Clarence M. Crites and Henry Feldman.

The ore is free-milling gold-bearing quartz ranging in value from \$25 to \$35 per ton. The associated minerals are chiefly antimony sulfide (stibnite) although sulfides of lead, iron and zinc occur sparingly. The stibnite often occurs in lenses or kidneys but the amount of sulfides rarely exceeds five per cent of the total vein material. In the surficial portions the ore is oxidized and frequently stained to a greenish color due to antimony oxide. No distinct ore shoots have been observed, and if secondary enrichment has taken place it is not a prominent characteristic of the deposit. Two distinct periods of mineralization have been recognized, the first resulting in the deposition of the bulk of the quartz and some of the gold, the second in the deposition of the sulfides, the remainder of the gold and a small amount of quartz. There is no "barren zone," the values being found practically at the grass roots.

The ore occurs in fissure veins which cut the laminations of the Birch Creek schist country rock. Four principal veins have been discovered, one on the Helen S. claim and three on the Hiyu and Nars claims. The Helen S. vein has been traced (by underground workings and prospect pits) for a distance of 2,000 feet from the level of Moose Creek across the Helen S. and Teddy R. claims to the Hiyu, which is situated near the top of the ridge between Moose and Too Much Gold Creeks. It ranges in thickness from 6 to 15 inches, the average being approximately 9 inches. The general trend of the Helen S. vein is N. 65° W., although local variations from this strike have been observed; it is practically perpendicular and intersects the veins on the Hiyu claim. The main vein on the Hiyu claim has been traced into the Nars claim, which is situated on the Too Much Gold Creek slope of the ridge, and was formerly owned by Nars, Anderson and Gibbs. It is from 10 to 12 inches thick and has a strike of N. 80° W. with a vertical dip. At a point approximately 1,000 feet from the east end line of the claim a smaller vein ranging from 4 to 6 inches in thickness, branches from the main Hiyu vein. It has a strike of N. 75° W. and the dip is nearly vertical. A third vein has been discovered on the Hiyu claim having an east and west strike and a steep dip to the north. It should intersect the other Hiyu veins on the Nars claim. It is 14 to 16 inches thick, but the gold values it carries are lower than those in the other two Hiyu veins. On the Nars claim the extension of the main Hiyu vein ranges from 6 inches to 2 feet in thickness although

in a few places, due to mineralization of the wall rock, as much as 6 feet might be mined profitably.

The ore is not generally "frozen" to the walls, but gouge which might indicate subsequent movement along the direction of the vein is not common. Two intersecting faults have been observed, however, one on the Helen S. with a comparatively small displacement to the north, and one on the HiYu, with a displacement of 30 feet to the south.

In addition to numerous prospect pits the development work on the HiYu group consists of three tunnels and a raise on the Helen S. claim, a tunnel and a shaft on the HiYu claim and a shaft on the Nars claim with two short drifts at the bottom. The main tunnel on the Helen S. claim starts at a point about 50 feet above the level of Moose Creek and extends northwest along the strike of the vein for a distance of 1,000 feet. At the 250-foot station a raise has been driven to the surface. A second tunnel at the level of the creek also extends along the vein for a distance of 500 feet. A third tunnel starting on the vein at a point approximately 175 feet above the main tunnel has been driven a distance of 40 feet. It will be extended through the Teddy R. claim and beneath the workings on the HiYu claim. The tunnel on the HiYu starts near the eastern end line of the claim at a point about 500 feet above the level of Moose Creek and extends westward along the main vein for a distance of 1,300 feet. An additional 200 feet has been driven along the branch vein described above. A shaft, which is now used for ventilation but through which a considerable tonnage of ore was hoisted during the prospecting stage of development, extends from the surface to the 800-foot station of the HiYu tunnel. On the Nars claim the shaft is 100 feet deep and two drifts, one 50 feet and the other 60 feet in length, have been turned off at the 60-foot level.

Overhead stoping is employed. The stopes are just wide enough to permit work in them, the average being about 2 feet. Chutes are spaced 50 feet apart. Ore is delivered through them to 17-cubic-foot steel mine cars and trammed to the surface on an 18-inch, 8-pound track. The waste is sorted underground and used to fill the worked-out stopes. On the Helen S. claim, with the exception of a floor five feet in thickness under the main tunnel, all of the ore between the creek level and main tunnels has been stoped for a distance of 400 feet from the portal, and between the main tunnel and the surface of the hill for a distance of 800 feet. On the HiYu claim all of the ore between the tunnel and the surface has been removed for a distance of 1,100 feet from the portal with the exception of a block 150 feet wide near the middle of the tunnel. A block 75 feet in width and extending to the surface was also taken from above the tunnel along the branch vein. The raise on the Helen S. and the shaft on the HiYu claim are not protected by pillars but are cribbed carefully and the adjoining stopes have been filled with waste. No pillars are left in the stopes and it is expected to remove ultimately all the ore both in the Helen S. and the HiYu claims. On the Nars claim approximately 200 tons of ore were removed by the former

owners during prospecting. The present owners have not continued this work as they expect to mine the Nars claim from the tunnel on the adjoining HiYu claim.

The property is equipped with a five-stamp amalgamating mill having a capacity of 15 tons in 24 hours. Ore is hauled with teams from the 50-ton bin at the portal of the HiYu claim and dumped into an underground chute above the main tunnel of the Helen S. claim. From here it is trammed in mine cars to the mill. After passing through a 7 by 9-inch Blake crusher, it falls into a 40-ton bin from which it is fed by a Challenge type feeder to the stamps. There are five of these in the battery, each weighing 1,000 pounds and dropping 95 to 100 times per minute. The battery has a 50-mesh screen, through which the ground pulp passes to the amalgamating plate, which is 4 feet wide and 20 feet long and is provided with a mercury trap at the lower end. The tailings are being collected in a settling pond for possible future treatment, as they carry on the average approximately \$4 in gold. The mill is ordinarily operated for one 8-hour shift daily except during the winter months, when it is idle.

Power for the mill is supplied by a 40 horsepower Oil City boiler, burning wood fuel, consisting, for the past three or four years, of stumps collected from the neighboring claims, the available supply of standing timber having been exhausted. The price of such fuel is variable, but on the average it is not far from \$12 for the equivalent of a cord. The boiler also supplies power for an Ingersoll-Rand air compressor which furnishes air for a Leyner drill sharpener, four Ingersoll-Rand stopers and five jack-hammer drills.

Work on this property has been continuous, except for temporary seasonal interruptions, since 1912. During that year prospecting, which was conducted by means of surface pits and trenches, revealed several veins ranging from 1 to 3 feet in thickness and carrying values of \$50 to \$75 at the surface. During 1913 the main tunnel on the Helen S. claim was driven 450 feet and the raise at the 250-foot station was driven to the surface. The creek level tunnel was also started. The following year the main tunnel was extended to 550 feet and the lower tunnel to 450 feet, both in ore throughout the entire distance. The stamp mill was moved to the property from Chatham Creek and began crushing ore on September 1st. In 1915 the main tunnel was extended to 700 feet and a considerable body of ore between it and the lower level was mined and milled. In 1916 the HiYu tunnel was started and the balance of the ore that has been taken from the Helen S. claim was mined and milled. Since 1916 work has been confined almost entirely to the HiYu claim; and with one exception this is the only property in the Fairbanks district that has operated steadily throughout this entire period. As opportunity afforded, during that time the various interests in the Nars, Anderson and Gibbs claims were purchased, and it is the intention to extend the workings from the adjoining HiYu claim into the Nars claim as soon as possible.

## Ohio Group.

The Ohio group, which is owned by Thomas Gilmore and Gilbert B. Stevens, includes the Ohio, Mayflower, Early Bird and Grey Eagle claims, which are situated on the north side of Fairbanks Creek, a short distance west of Too Much Gold Creek. The property is three miles from Meehan, the nearest postoffice, and 24 miles northeast of Fairbanks. The distance to Gilmore is 12 miles.

The principal development work on the Ohio Group consists of a crosscut tunnel which starts just below the wagon road near the lower end of the property and runs N. 30° E. for a distance of 1,000 feet and thence in an easterly direction for 150 feet to the foot of the "upper" shaft on the Ohio claim. At the 700-foot station a branch tunnel follows a small stringer for 50 feet in a northerly direction; near the 800-foot station there are two branches, one in a northerly direction 100 feet in length and one in an easterly direction 75 feet long; and at the 1,000-foot station a fourth branch turns sharply to the west and connects with the 200-foot level of the main shaft on the adjoining Mizpah claim. The total length of the tunnel from this shaft to the portal is 1,350 feet. Besides this tunnel several prospect shafts varying in depth from 30 to 80 feet have been sunk on the claims of the Ohio group and have encountered a variety of stringers and veins.

At the bottom of one of these shafts, which is 25 feet deep, there are two veins 15 feet apart, having a strike of approximately N. 70° W., with a dip of 45° S., but which at the surface are only 4 feet apart. The upper hanging wall of these veins shows strong slickensides and pronounced vertical streaks, indicating a fault plane along which the southern block has been relatively down-thrown. The ore along the foot wall merges into the schist country rock. A second shaft which is 57 feet deep has exposed an eight-inch vein having an east-west strike with a dip of 45° N. The ore in this vein, which is also free-milling, is of low grade, perhaps \$4 or \$5 per ton. At the bottom of a third shaft, which is 70 feet deep, a drift was started in an easterly direction and then turned to the north. In this drift, which is 70 feet long, a quartz vein 4 to 6 inches thick was discovered carrying free-milling gold with some pyrite and stibnite. The vein strikes east and west and dips 45° N. The "upper" shaft on the Ohio claim exposed a body of low grade ore containing a large amount of sulphides, particularly galena and stibnite. And on the Early Bird claim a 25-foot shaft has uncovered a kidney shaped body of stibnite 12 to 15 inches thick.

The property is equipped with a five-stamp mill, which was installed in 1915. The ore is dumped from the mine cars as they come out of the tunnel over a 1½-inch grizzly. The oversize is crushed in a 7 by 9-inch Blake crusher and falls with the undersize from the grizzly to a small bin from which it is delivered to the stamps by a Challenge feeder. The stamp battery contains five 1,000-pound stamps which drop 95 times per minute and crush the ore through a 40-mesh slotted screen. The ground pulp passes over two 4½ by 8-foot amalgamating plates ar-

ranged in series with a 1-inch step between them and having a slope of 2 inches per foot. The lower plate is equipped with a mercury trap from which tailings are discharged as waste with no attempt to save them. Power for the mill is derived from a 30-horsepower, locomotive type, Erie boiler, which supplies steam for an 8 by 10-inch single cylinder engine, running at 180 r. p. m. The mill is housed in a neat, well constructed building.

## Mizpah Mine.

The Mizpah mine, which is owned by Chas. L. Thompson of Fairbanks and associates, is situated on the north side of Fairbanks Creek just west of the Ohio group.

Two parallel veins 150 feet apart, having an east and west strike and a dip of 75° S., have been discovered on the claim. The first or Mizpah vein ranges from 1 to 2½ feet in thickness. The ore is chiefly free-milling gold-bearing quartz, but shoots of galena and lead carbonates carrying high values in silver occur at irregular intervals. An inclined shaft has been sunk on this vein to a depth of 220 feet at a point 250 feet from the east end line of the claim and drifts along the vein in both directions have been driven at the 80, 160 and 220-foot levels. At the 80-foot level the drifts are each 100 feet in length; at the 160 and 220-foot levels the east drifts are 100 feet and the west drifts 175 feet in length. The east drift on the 220-foot level connects with the Ohio tunnel. Approximately 1,500 tons of ore, the average value of which is reported to have been \$25 per ton, have been stoped from these drifts and milled at the Ohio and other neighboring mills. The second vein is 5 to 16 inches wide and carries approximately 20 per cent stibnite with some free gold in a quartz gangue. A shaft has been sunk to a depth of 120 feet on this vein.

## War Eagle Group.

The War Eagle group is situated on the divide between the headwaters of Fairbanks and Wolf Creeks, and includes the War Eagle, Leroy, Pioneer, Iron Mask and Black Warrior claims, extending from west to east in the order named. They are four miles west of Meehan.

The bulk of the work for this group has been done on the Pioneer claim, where several shafts and a number of prospect pits have exposed an antimony bearing vein 18 inches in thickness, having a strike of N. 85° E. and dipping 80° N., together with three free-milling gold quartz veins ranging in thickness from 6 inches to 14 inches. A small tonnage of ore has been shipped to various custom mills in the district from a part of which exceptionally high returns are reported.

## CLEARY CREEK

## Rexall Mine.

The Rexall mine is situated near the head of Wolf Creek, the easternmost branch of Cleary Creek. It is 2½ miles southeast of Cleary post-



office and 6 miles from Chatanika, the terminus of a 35-mile narrow gauge branch of the Alaska Railroad.

The mine was opened by a tunnel running N. 25° E. along the strike of a 3-foot quartz vein which dips 25° NW. At a point 140 feet from the portal a smaller east-west vein dipping 60° N. was intersected and since this carried higher values in gold, subsequent work was confined to its exploitation. It varied from 12 to 18 inches in width, the vein material being chiefly quartz and containing but a small amount of sulphides. A well defined and slickensided gouge seam occurred on the hanging wall. A shipment consisting of 25 tons of this ore was milled at Fairbanks, from which an average recovery of \$112 per ton is reported. The development work on the vein consisted of 500 feet of drift, several raises and a winze. A mill was erected on the property, consisting of a Blake crusher, a Joshua Hendy 2-stamp mill and an amalgamating plate. The stamps weighed 1,000 pounds each and were set for an 8-inch drop. The mill was run by an Otto gasoline engine, which also pumped water for the mill from a well beneath the engine room. The mill was later sold to the owners of the David mine and moved to Skoogy Gulch.

#### Homestake Mine.

The Homestake mine is situated on Wolf Creek, a short distance above the Rexall.

Early prospecting revealed several promising veins on the surface and a tunnel was driven 750 feet in a southerly direction to intersect them. The first one of importance was encountered at a point 320 feet from the portal. It has an east-west strike and dips 45° S. It varies from 3 to 12 inches in width and in places carries high values in gold. The vein matter is chiefly quartz containing small amounts of antimony, copper and iron sulphides. Drifts were turned off to the east and west along its strike.

In the west drift a small pocket of high grade ore was found at a distance of 50 feet from the tunnel. In the east drift the first 90 feet from the tunnel were low in gold content, but the next 160 feet were driven through a good ore shoot about 12 feet high. The drift extended 50 feet beyond this through barren material to a point 300 feet from the tunnel, where the vein was split up into several stringers. At a point in the east drift 135 feet from the tunnel an inclined raise driven 150 feet up the 45° slope showed the vein to be continuous to the surface, although much of it was barren. A second rich shoot was found, however, 30 feet above the drift. It was 10 feet high and extended for more than 100 feet along a horizontal pitch. The thickness of the vein averaged 9 inches in this shoot. A second raise in the east drift at a point 235 feet from the tunnel disclosed another shoot of high grade ore at a point 100 feet above the drift. The vein in this shoot averaged 5 inches in thickness and had a strike of N. 68° E. and a dip of 40° S.

The second vein was encountered 600 feet from the portal of the tunnel. It strikes N. 60° W. and dips 45° N. The vein matter is chiefly iron

stained quartz in which visible particles of gold are occasionally found. Sulphides are not abundant, although stibnite, pyrite and chalcopryrite were observed. A drift was turned off for 100 feet along this vein, in which it averaged one foot in thickness. At the face of the drift it pinched to a seam of gouge.

#### Pennsylvania Mine.

The Pennsylvania mine is situated about a quarter of a mile south-east of the Rexall near the top of the divide between Wolf and Fairbanks Creeks. It lies but a short distance north of the War Eagle group.

The principal work at this mine consists of an inclined shaft 150 feet deep which was sunk on a vein about a foot thick, having a strike of N. 76° W., and a dip of 58° S. Short drifts 25 to 30 feet long were run to the east and west at the 50-foot level, from which a small tonnage of selected ore was mined.

The property was equipped with a Little Giant mill, having a capacity of 8 to 15 tons per day. From the mill the ground ore passed over amalgamated plates and hence through a launder to a Monarch table. The mill was situated on Fairbanks Creek about a half mile from the property.

#### Chatham Mine.

The Chatham mine is located at the head of Chatham Creek, which joins Cleary Creek about a mile above the mouth of Wolf Creek. The mine is three miles from Cleary postoffice and a half a mile southwest of the Homestake mine.

The main vein, which ranges in width from 6 to 18 inches, has a strike of N. 60° W. and dips 65° to 80° SW. After it had been traced for more than 500 feet by surface excavations, a crosscut tunnel was started in the side of the hill 180 feet below the outcrop. The tunnel intersected the vein at a distance of 200 feet from the portal where drifts were turned off along the vein to the northwest and southeast for distances of 400 and 500 feet respectively. Raises were driven at 35-foot intervals from the drifts, several of them extending to the surface, and nearly all of the ore was stoped out for a distance of 175 feet from the tunnel to the northwest and 225 feet to the southeast.

The vein material is chiefly quartz containing a small amount of arsenic, antimony and iron sulphides. Faults of small displacement are a common occurrence and some movement has also taken place along the strike of the vein. Although the value of the ore, which is reported to be \$25 to \$40 per ton, varies from place to place, the vein contains but few barren spots on the one hand or grade pockets on the other.

The main tunnel was extended to a distance of 1,300 feet from the portal. At the 850-foot station a second vein carrying a large percentage of stibnite was encountered. It strikes N. 70° E. and is practically vertical. A raise was driven 100 feet to the surface, and during 1916 a considerable tonnage of antimony ore was mined from it. What is probably a con-

tinuation of this stibnite vein cuts the main gold-bearing vein in the east drift at a point 150 feet from the tunnel.

The property is equipped with a 4-stamp mill consisting of two batteries of two 1,000-pound stamps each, crushing the ore to 40-mesh. The ground pulp passes over amalgamating plates equipped with mercury traps, the tailings going to waste. The mill is situated on Chatham Creek about a mile below the mine.

#### Pioneer Mine.

The Pioneer mine is located on the east side of Chatham Creek, about three-quarters of a mile above the mouth.

The underground workings at this property, which was one of the first lode mining operations in the district, have long been inaccessible. They are reported to consist of an adit 125 feet long and a shaft about 100 feet deep with drifts to the east and west at the bottom, from which 200 tons of ore were treated at the mill erected in 1912.

It contained five 1,000-pound stamps of the Joshua Hendy pattern, dropping 100 times per minute. The ground pulp passed over two amalgamation plates, placed in series, and fitted with a mercury trap and auxiliary riffles. It was sold to Crites and Feldman and moved to the Hiyu group on Fairbanks Creek in 1914.

#### Free Gold Mine.

The Free Gold mine, also known as the Rhoads-Hall property, is situated on the east side and near the mouth of Bedrock Creek, which flows into Cleark Creek a half mile west of Chatham Creek. The mine is two miles southwest of Cleary postoffice and 25 miles northeast of Fairbanks. The distance to Chatanika, the nearest railroad station, is six miles over a fairly good wagon road.

The ore deposit occurs in a series of fissure veins, consisting of a main vein which ranges from 1 to 3 feet in thickness with a small parallel stringer about 25 feet distant on each side. The gold is irregularly distributed through the vein material and in most cases uncombined with other minerals. In places it is more abundant near the walls of the vein and at others the vein is richest near the center. The sulphides of arsenic and antimony are often found associated with the gold in small amounts. The sulphides of zinc, lead, copper and iron are also occasionally present. The gold values appear to be higher wherever the quantity of sulphides is greater than usual. The vein material is grayish white opaque quartz, which is usually compact in texture.

The hanging and foot walls are Birch Creek schist and the vein cuts the lamination of the schist on a strike of N. 65° W. to N. 75° W. and at dips varying from 55° S. to 63° S. A number of instances of faulting have been observed and near the portal of the main tunnel the rock has been so thoroughly shattered and broken that the vein is almost unrecognizable for a distance of 200 feet. Two sets of faulting have been recog-

nized, one across the vein with a high inclination, the other nearly parallel and practically flat. The displacement is usually small.

Here, as in the case of many other mines in the district, the gold has evidently been introduced at two distinct periods, although these may not have been separated by any appreciable geologic time. During the first period most of the quartz which forms the bulk of the vein and some of the gold were deposited. The second period resulted in the introduction of the sulphides, a small amount of quartz and the remainder of the gold.

Development work at the property includes a main tunnel, starting about 50 feet above the level of the creek, an intermediate adit known as the Penrose tunnel 150 feet higher, and an upper adit 50 feet above the Penrose. The main tunnel is 1,300 feet long, the intermediate tunnel 280 feet and the upper adit 200 feet. At a point 800 feet from the portal of the main tunnel a winze follows down the vein for a distance of 112 feet. Drifts, aggregating 3,200 feet in length, have been driven in both directions along the vein at the 70-foot level and at the bottom of the winze.

The property is equipped with a mill situated near the main tunnel in which the ore, after preliminary reduction in a jaw crusher, was fed to a stamp battery containing five 1,000-pound stamps. These crushed the ore through a 40-mesh screen, after which it passed over amalgamating plates. The tailings were treated on a canvas table where some of the slimed sulphides were removed as concentrates and shipped to a smelter. The mill has a capacity of 17 tons in 24 hours. The value of the ore fed to the mill while the property was being operated is unknown, but it is believed to have been \$30 or \$40 per ton. The loss in the tailings is reported to have been high.

The mine was discovered in 1908 and during the following year the vein was traced for 800 feet along the outcrop and the main tunnel driven 90 feet. In 1910 the tunnel was extended to 630 feet. By the end of the following year 1,200 feet of underground work had been completed and the mill erected and put in operation. During 1912 the main tunnel was extended to 975 feet, the intermediate and upper tunnels were started and the winze was sunk to a depth of 20 feet. By the end of 1913 the main tunnel had reached the 1,280-foot station, the intermediate tunnel had been driven to 300 feet and the upper tunnel was 200 feet long. The winze was sunk to a depth of 112 feet and drifts aggregating 1,000 feet in length were turned off at the 70 and 110-foot levels. The main and intermediate tunnels were connected by a raise and much of the ore between them removed. Approximately 3,000 feet of development work were done during 1914, of which 2,000 feet was on the 70 and 110-foot levels of the winze, and 1,000 feet consisted of connections between the various levels. The mill operated 350 days during the year. An additional 200 feet of underground work was done the following year before operations were suspended on September 10, 1915, because of the increased operating expenses due largely to the high cost of fuel for pumping the water from the lower levels. They have not been resumed, although the mill has been used since then for short runs by other parties.



The total production of gold from this property is reported to have been approximately \$600,000.

#### Wyoming Group.

The Wyoming group consists of nine claims, including the Alabama, California, Pauper's Dream, Texas and Wyoming, situated on the ridge between Bedrock and Chatham Creeks above the Free Gold Mine.

On the Wyoming claim an east-west vein 1 to 2 feet thick, consisting chiefly of quartz carrying free gold, has been opened by a tunnel 165 feet long and a winze 50 feet deep. The tunnel starts on the east side of Bedrock Creek about 1,000 feet south of the Free Gold mine. The winze starts near the middle of the tunnel and follows a 60° dip which flattens to 50° near the bottom. The vein has been traced into the neighboring Alabama claim by a series of open cuts on the surface.

An east-west vein, having a dip of 60° S., has been exposed on the California claim. It contains from 1 to 3 feet of free-milling gold quartz. A shaft has been sunk on it for 60 feet, and near the bottom the dip of this vein also flattens.

A third vein which has a north-south strike and a steep dip to the west is exposed on the Texas claim north of the California. It has been traced across the latter claim into the Pauper's Dream on the south. The vein is from 2 to 4 feet wide and has a steep dip to the north. It differs from the other two veins on the property by carrying a rather large amount of sulphides consisting mainly of arsenopyrite.

#### Tolovana Mine

The Tolovana Mine is situated near the mouth of Willow Creek, a tributary of Cleary Creek, lying about a half a mile west of Bedrock Creek. The property is 2½ miles southwest of Cleary postoffice and 6 miles from Chatanika.

The main development consists of a tunnel that runs N. 75° E. for 130 feet along a vein or shear zone composed of a number of small quartz stringers ranging from less than 1 inch up to 3 inches in thickness. From this point the tunnel follows a fault, which has offset the vein for 30 feet to the north, and then along the vein for 200 feet. An inclined shaft 100 feet deep has been sunk on the vein near the mouth of the tunnel, and a winze in the tunnel at a point 100 feet from the portal is also 100 feet deep. A drift connects the bottom of the shaft and the winze, and most of the ore between them has been mined and milled. A drift also extends east from the 50-foot level of the winze until it encounters the fault discovered in the main tunnel.

The ore in this lode is white, milky quartz interbanded with schist. The gold in it is free milling but appears to have some association with the small quantity of sulphides, chiefly stibnite, scattered through the quartz. The stringers are usually "frozen" to the schist, which on that account forms a considerable proportion of the ore going to the mill.

About 100 feet south of the main tunnel a 50-foot shaft has exposed a vein of quartz ranging from 1½ to 3 feet in width and having two well defined walls. Drifts were run 15 and 20 feet to the west and east, respectively, along the strike of the vein, which dips 50° S. It carries a considerable amount of stibnite and free gold is visible both in the stibnite and in the quartz.

A shaft has also been sunk on an adjoining claim lying northeast of the Tolovana claim to a depth of 100 feet, from the 50-foot level of which drifts were turned off to the east and west along the vein for 50 and 30 feet, respectively. From the end of the west drift a raise was driven to the surface and the block of ore between the raise and the shaft was mined and milled. The vein contains quartz and stibnite, with smaller quantities of other sulphides.

The ore was originally treated in a Huntington mill, but this was replaced in 1912 by a 2-stamp Nissen mill. The stamps weigh 1,300 pounds each and crush the ore through a 40-mesh screen. The pulp then passes over the amalgamating plate, after which the sulphides are removed from the tailings by an endless conveyor belt operated something after the principle of a Frue vanner. The capacity of the mill is 6 to 8 tons per 24 hours.

#### Eldorado Mine.

The Eldorado mine is situated on the headwaters of Cleary Creek about half a mile southwest of the Tolovana mine.

The development consists of 2 shafts and 3 drifts on a vein from 3 to 5 feet wide, striking N. 35° E. and dipping 85° N. The southwest-erly shaft is 45 feet deep, 4 by 8 feet in size and is timbered and cribbed. From the bottom drifts have been driven along the vein in both directions, the one to the southwest being 30 feet and the one to the northeast 45 feet in length. They are timbered only where necessary and are 4 by 6 feet in size. Starting at a point 15 feet from the shaft along the south side of the northeast drift, a stope has been mined which is 25 feet long, 20 feet wide and 12 feet high. A body of silver bearing galena 2 to 3 feet in thickness was mined from this stope, and shipped to the smelter at Tacoma without concentration, but around the edges of the stope pyrite and zinc blende became predominant and further mining was discontinued. The ore body in the stope, before its removal, was found in practically a horizontal position, in contrast to the vertical position of the vein.

The northeasterly shaft, which is 4 feet by 6 feet in dimensions, has been sunk to a depth of 35 feet at a point 200 feet from the first shaft. It is also timbered to the full depth. From the bottom a drift extends for a distance of 45 feet southwest along the vein.

The ore contains a complex mixture of pyrite, galena, zinc blende and stibnite in a gangue composed largely of quartz. The country rock in the vicinity is highly metamorphosed limestone. The different minerals composing the ore are intimately intermixed and, generally speaking, the size of the individual crystals is small. The ore carries silver in the

proportion of 2 to 2½ ounces of silver per ton for every percent of lead. The most of the silver is contained in the galena but there is, in addition, no doubt a small amount of silver mineral present—possibly a sulphide or antimonide. In the oxidized portion of the vein, which extends to a depth of about 30 feet from the surface, the pyrite is changed to limonite and a part of the galena to carbonate; the zinc content is extremely low, and the presence of silver chloride is suspected.

Approximately four tons of this ore was tested at the Alaska Station of the Bureau of Mines in 1918, and a mill was designed for the treatment of the ore, the construction of which, however, was not recommended until a much larger tonnage of ore had been blocked out. The lessees were unable to do this at the time for financial reasons and the property has remained idle.

#### LITTLE ELDORADO CREEK

##### Newsboy Mine.

The Newsboy mine is situated at the head of Little Eldorado Creek, just over the divide from Cleary Creek. It is 7½ miles from Gilmore station on the Chatanika branch of the Alaska Railroad.

The vein trends N. 40° E. with a dip of 73° NW., and averages 2 or 3 feet in thickness. In places, however, the vein splits and encloses a horse of highly mineralized schist, permitting the mining of 12 to 14 feet of ore. Fine grained quartz is the most abundant mineral but the vein carries a larger proportion of sulphides than most of the other mines in the district. The sulphides are chiefly pyrite and stibnite.

The mine has been developed by an inclined shaft 350 feet deep. Drifts aggregating more than 1,500 feet in length have been turned off at the 60, 115, 150, 215 and 315-foot levels and most of the ore between the upper levels has been stoped out for a distance of 75 to 100 feet from the shaft. Mining operations at this property were seriously hampered by an extremely complicated system of faults at which the best ore terminated abruptly, particularly that northeast of the shaft. In the absence of a knowledge of the exact relation and composite result of this faulting, several hundred feet of drifting failed to locate the vein again, and in 1915 the mine was closed down for lack of funds, in spite of a production of nearly \$150,000.

The ore was milled in a 5-stamp Hendy mill which was originally set up near the collar of the shaft but was later (1912) moved to a site on Cleary Creek opposite the mouth of Willow Creek, where a more adequate supply of water is available. The tailings from the amalgamating plates were treated on a No. 2 Deister concentrator in order to save the sulphide in the ore.

#### DOMO CREEK

##### Soo Mine.

The Soo mine is situated at the head of Dome Creek, about four miles east of Ridgetop on the Chatanika branch of the Alaska Railroad.

The property, which locally is sometimes called the Spaulding mine, includes among others the Wild Rose, Soo, Waterbury and Carnation claims, which trend from west to east up the steep slope at the head of the creek.

The principal development work centers around an inclined shaft near the end line between the Wild Rose and Soo claims. It follows the vein, which has been named the Wild Rose, to a depth of 100 feet and drifts 440 and 300 feet in length have been turned off to the east at the 50 and 100-foot levels, respectively. Most of the ore between these levels has been mined and milled. A second shaft was sunk on the same vein a short distance to the west from which some ore was also mined and milled.

The Wild Rose vein has an east-west trend and a steep dip to the north. The ore is chiefly quartz containing but a small amount of sulphides, which include stibnite and galena. Several faults of relatively small displacement were encountered in mining. The width of the vein is irregular, in some places being a mere seam of gouge, and at others widening to as much as seven feet.

A second vein, which also has an east-west trend and a steep dip to the north, has been named the Soo vein. At the west end line of the Soo claim the vein is 135 feet north of the Wild Rose, while at the east end line of the Soo claim the distance between the veins is only 60 feet. It has been prospected by a shaft 100 feet deep at the east end of the Soo claim and by a crosscut tunnel near the center of the claim.

The mine is equipped with a 2-stamp Joshua Hendy mill, situated on Dome Creek half a mile from the mine. The ore was crushed at the mine before being hauled to the mill. The stamps weigh 1,000 pounds each and crushed the ore through a 40-mesh screen. The tailings from the plates were discharged into a Pierce amalgamator which caught any quicksilver or rusty gold that passed over the plates. The capacity of the mill is reported to have been 10 tons in 24 hours.

#### VAULT CREEK

##### Fredericks Mine.

The Fredericks mine is situated on the ridge between Vault and Dome Creeks. The Chatanika branch of the Alaska Railroad crosses the property, although Ridgetop station lies about a mile to the north.

The property is developed by two shafts and a series of open cuts. The western shaft is 300 feet deep and from it levels have been turned off along the vein in both directions at the 100, 200 and 300-foot levels. These workings have exposed a fissure vein about three feet in width which strikes N. 70° W. and dips 70° N. at the surface but flattens to 45° at the bottom of the shaft. The chief vein material is quartz containing some free gold and, in places, considerable masses of stibnite. The eastern shaft is 100 feet deep and in it the 80° dip of the vein does not change in depth. The mineralization at this point has taken place in a fissured zone which has no well defined walls.

## PEDRO CREEK

## Rainbow Mine.

The Rainbow mine is situated a short distance north of the junction of Skoogy Gulch with Twin Creek, which is one of the principal tributaries of Pedro Creek. The distance to Gilmore, the nearest point on the Chatanika branch of the Alaska Railroad, is five miles.

The ore occurs in a fissure vein having an east-west trend and a vertical dip. The vein averages from 10 to 12 inches in thickness and the vein material is glassy quartz containing rarely more than three per cent of sulphides. The chief sulphides are pyrite, arsenopyrite and stibnite, but galena and sphalerite have been identified. Visible gold is rare, although the ore is free milling. At the west end of the property the vein intersects a granite dike, which dips N. 45° E., but in the remainder of the property the walls of the vein are schist. The ore occurs in shoots which dip 45° E., three of which were encountered in the 600 feet of the vein exposed on this and the adjoining property, the David.

The ore from the Rainbow mine has been taken out through a shaft 130 feet deep, which was sunk at a point 250 feet east of the end line of the claim. From the 100-foot level of the shaft drifts were run along the vein for 125 feet to the east and 250 feet to the west. Chutes were spaced at 35-foot intervals in the drifts. Approximately 1,500 tons of ore, which is reported to have averaged \$25 per ton, were mined before the property became involved in litigation which lasted from 1914 to 1920, during which the mine was idle.

## David Mine.

The David mine is located on Skoogy Gulch, adjoining the Rainbow mine.

The vein, which is the western extension of the Rainbow vein, ranges from 8 to 10 inches in thickness and has an east-west trend with a vertical dip. The character of the ore is similar to that found in the Rainbow mine.

The property was developed by an adit starting on the east side of Skoogy Gulch about 20 feet above the creek level and running 300 feet east to the end line of the Rainbow claim. All of the ore between the tunnel and the surface has been mined and milled.

The mill contains a 7 by 9-inch Blake crusher, two 1,000-pound Joshua Hendy stamps, dropping 92 times per minute and crushing the ore through a 40-mesh screen, a silver plated amalgamating plate 4 by 16 feet, a Pierce amalgamator and a 6-foot Johnson vanner. Power for the mill is derived from a 40-horsepower Erie boiler, burning wood fuel. It also supplies the power for the Ingersoll-Rand air compressor which furnishes air for the drills used in mining.

## Anderson and Burch Mine.

The Anderson and Burch property is situated three-quarters of a mile above the mouth of Granite Creek, which flows into Pedro Creek

just below the mouth of Twin Creek. It is  $4\frac{1}{2}$  miles from Gilmore.

The principal feature at this property is a lode, ranging from 35 to 45 feet in thickness, composed chiefly of quartz with a small amount of pyrite, arsenopyrite and stibnite. The ledge was first discovered in a shaft 35 feet deep on the east side of the creek, and a cross-cut tunnel nearly 400 feet long was driven from a point just above the creek level to intersect the vein. An 80-foot crosscut, starting at a point 250 feet from the mouth of the tunnel, also cuts the lode which crosses the main tunnel at an angle of about 45°. A shipment of several tons of ore taken out when driving this crosscut was tested at the Citizens Test Mill in Fairbanks and an average of \$5 per ton in gold is reported to have been recovered.

The tunnel intersects two other lodes, one about 18 feet thick at a distance of 50 feet from the portal, the other 57 feet thick at a distance of 185 feet. The first lode is a brecciated zone in the schist containing a number of small quartz stringers carrying pyrite and arsenopyrite. Although occasional rich specimens have been found, the ore as a whole is low grade. The second lode contains horses of schist between quartz vein matter interspersed with seams of blue-clay gouge. Arsenopyrite and pyrite are prominent constituents of the vein matter, which is low in gold content but contains some silver.

## SAINT PATRICK CREEK

## Billy Sunday Mine.

The Billy Sunday mine, formerly known as the Leah or the Smith and McGlone property, is situated on the eastern flank of Ester Dome, near the head of St. Patrick Creek. It is  $1\frac{1}{2}$  miles from Berry, the nearest postoffice, and 11 miles from Fairbanks. The distance to Happy, which is the nearest railroad station and the junction point between the Chatanika branch and the main line of the Alaska Railroad, is  $2\frac{1}{2}$  miles.

The underground work includes two inclined shafts, one of them 195 feet and the other 100 feet deep, together with about 500 feet of drifts and levels. At the 60-foot level of the main or deeper shaft one drift runs 100 feet northeast, where it connects with the other shaft, and another drift runs southwest for 120 feet. At the 120-foot level drifts run to the northeast and southwest for 60 and 125 feet, respectively. At the bottom of the shaft a drift runs 60 feet northeast and another 50 feet southwest. A 50-foot crosscut was driven in a southeasterly direction from the north drift on the 120-foot level, and a winze sunk to a depth of 70 feet from the end of the crosscut. Most of the ore has been mined for a distance of 60 feet on both sides of the shaft between the 120-foot level and the surface.

The ore occurs in a fissure vein from 2 to 5 feet thick, having a strike of N. 35° E., and a dip ranging from 70° SE. to vertical. The vein material is mostly quartz containing a small amount (rarely more than three percent) of sulphides, including pyrite stibnite, some sphalerite and smaller amounts of galena. The ore is free milling and visible gold can

often be detected. The walls of the vein are schist. At a point about 30 feet below the collar of the main shaft the vein splits and encloses a horse of schist which is much shattered and filled with quartz stringers carrying some gold. At the 120-foot level a nearly horizontal fault has offset the vein about 50 feet to the southeast. The values in the vein appear to be original constituents and no indications of secondary enrichment have been observed in the 200 feet of depth thus far penetrated.

The ore is mined by the overhead stoping method, and falls into chutes spaced at 30-foot intervals along the drifts. It is skidded to the shaft and dumped into a 500-pound bucket which is hoisted along skids in the shaft by a 5-horsepower gasoline engine. At the collar of the shaft an automatic trip dumps the contents of the bucket into a mine car in which the ore is trammed on a short trestle and dumped into wagons for hauling to a nearby mill. An Ingersoll-Rand jackhammer and a Sullivan stoper are used in drilling, for which air is supplied by an Ingersoll-Rand compressor driven by a 12-horsepower gasoline engine. The cost of gasoline at the mine is 72½ cents per gallon.

The shafts are timbered and cribbed where necessary and tunnel sets are used in the drifts. A few stulls are also used in the stopes to hold the roof until the stopes can be filled with waste. The timber is local spruce logs ranging from 6 to 10 inches in diameter.

A small amount of water was encountered at the 200-foot level which will require a pump.

The ore is hauled by wagons to a mill belonging to Thomas and Hess on the St. Paul claim, seven-eighths of a mile distant, and dumped over a 2-inch grizzly, the oversize being broken by hand. From the grizzly the ore passes through a 7 by 9-inch crusher to a 60-ton bin from which it is delivered by a Challenge feeder to a 7-foot Lane mill. This crushes it through a 40-mesh screen, the ground pulp passing over an amalgamating plate 4 feet wide and 8 feet long. The tailings are allowed to go to waste. During a run of ore the mill is usually operated for one 12-hour shift per day and has a capacity of one ton per hour. The feed to the mill has averaged \$32 per ton and the loss in the tailings amount to about \$4.50.

The Billy Sunday is one of two mines in the district (the other being the Hiyu on Fairbanks Creek) that operated regularly during the years from 1918 to 1922 inclusive. Approximately 1,600 tons of ore have been mined and milled from which \$48,000 have been recovered. The property is owned by George M., Joseph H. and Edward H. Smith, of Fairbanks.

#### Ryan Lode Group.

The Ryan Lode group contains eight claims, including the Ryan, Edna, Monte and Eva claims, situated about a quarter of a mile south of the Billy Sunday mine, on the ridge between St. Patrick and Eva Creeks, the latter being a tributary to Ester Creek.

The greater part of the work at this property has been done on the Ryan lode, which has been traced by six shafts and a series of open cuts for more than 2,000 feet along the side lines between the Ryan and Edna

and between the Monte and Eva claims. The most extensive of these workings is a shaft 200 feet deep near the south end of the Ryan claim. At the 46-foot level it connects with the 100-foot station of an adit starting at the surface of the hill and extending 300 feet beyond the shaft and into the adjoining Monte claim. Three crosscuts, each about 50 feet long, have been driven from the adit cross the strike of the lode, and at the breast of the adit a winze has been sunk for 40 feet on the vein. At both the 100-foot and 200-foot levels of the shaft crosscuts 100 feet long were driven across the lode.

On the Monte claim near the top of the hill a second shaft has been sunk to a depth of 50 feet and a crosscut has been driven at the bottom for a distance of 150 feet. Approximately 300 feet southwest of this there is another shaft 40 feet deep. About 300 feet farther to the southwest, and on the Eva Creek slope of the hill, there is a shaft 50 feet deep with a 50-foot crosscut at the bottom, and at an additional 300 feet in a southwesterly direction there is still another shaft 35 feet deep. On the Ryan claim several hundred feet to the northeast of the main workings and down the slope of the hill towards St. Patrick Creek, another shaft has been sunk to a depth of 100 feet with a 40-foot crosscut at the bottom.

The ore in the Ryan lode occurs in a fractured or fissure zone ranging from 20 to 86 feet in width, and consists of a mixture of quartz and country rock containing a rather large amount (possibly as much as ten percent) of sulphides which are chiefly arsenopyrite and stibnite. The lode trends N. 30° E. and has a steep dip to the east.

A second and nearly parallel lode, lying 400 feet to the northwest, has been traced for several hundred feet by a series of shallow shafts and pits. It averages six feet in thickness.

During 1916 and 1917 this property was examined by a nationally known exploration company who spent some \$35,000 in prospecting the ore deposits in this vicinity. It is reported that their estimate of the available ore in the Ryan Lode group is 800,000 tons, having an average value of \$4 per ton.

#### Bondholder Group.

The Bondholder group includes the Bondholder, Bondholder Extension, Oakland, Oakland Extension and Yellow Jacket claims, situated at the head of the north fork of St. Patrick Creek, about half a mile north of the Billy Sunday mine. This group is often referred to as the Tyndall and Finn property.

A ledge ranging in width from 6 to 12 feet, with a strike of N. 20° E., and a dip of 40° NW., has been traced across the first four claims mentioned above, which are located along the trend of the vein in the order named. The vein matter is chiefly quartz and is frequently stained to a greenish color due to the oxidation of arsenopyrite. Other sulphides are of rare occurrence. The richest gold values are found near the hanging wall and particularly in the stained quartz.

The principal development work consists of a crosscut tunnel nearly 700 feet long, starting on the Yellow Jacket claim (which adjoins the Bondholder on the northeast) at a point 250 feet vertically below the outcrop of the Bondholder ledge and driven to intersect that lode. In addition three shafts, two of which are nearly 150 feet deep, have been sunk on the ledge. At the 55-foot level of one of these a drift was driven for 50 feet to the southwest along the vein, which at this point has a mineable thickness of twelve feet.

#### Mohawk Group.

The Mohawk group includes the Mohawk and Mohawk No. 2 claims, situated just north of the Billy Sunday mine.

Two shafts on this property, each about 50 feet deep, have exposed a well defined ledge ranging from 2 to 8 feet in thickness. It is believed to be the extension of the Billy Sunday lode. The vein matter is quartz containing a small amount of stibnite and sphalerite. During the summer of 1922 approximately 300 tons of ore were mined from the Mohawk claim and treated at the neighboring St. Paul mill, from which a recovery of more than \$12,000 is reported.

#### Last Chance Prospect.

The Last Chance prospect is situated on the ridge at the head of St. Patrick Creek between the Mohawk and Bondholder properties.

A 60-foot shaft which was sunk during 1922 exposed a quartz vein about two feet thick, striking approximately N. 45° E. and dipping steeply to the north. The vein material is chiefly quartz containing a small amount of arsenic and antimony sulphides. Visible gold can often be detected. Short drifts were turned off at the bottom of the shaft along the vein from which about 125 tons of ore were mined. The ore was treated in the St. Paul mill, near by, and is reported to have yielded an average of \$30 per ton.

### ESTER CREEK

#### Saint Paul Mine.

The Saint Paul mine is located at the head of Eva Creek, the easternmost tributary of Ester Creek. The property is 1½ miles from Berry, the nearest postoffice, and 3½ miles from Happy Junction on the Alaska Railroad.

The principal development work consists of a tunnel nearly 400 feet long, which has been driven on a 3-foot vein of massive white vitreous quartz having a strike of N. 40° E. and a dip of 38° NW. The quartz is shattered and iron stained and often contains irregular bodies of stibnite. It is believed that the gold found in this vein was deposited with little or no silica at a date subsequent to the formation of the quartz vein, which was probably barren of gold when first formed. Several hundred tons of ore have been mined and treated in the 7-foot Lafe mill

on the property, the details of which are included in the description of the Billy Sunday mine.

#### Hudson Mine.

The Hudson mine is situated on the west side of Ready Bullion Creek, a tributary of Ester Creek lying about a mile west of Eva Creek. The property is a mile from Berry postoffice and six miles from Ester station on the main line of the Alaska Railroad.

The main opening of the Hudson mine is a 200-foot shaft from which a large amount of drifting has been done, chiefly at the 100-foot level. At this depth a 20-foot crosscut to the west intersected a fissured zone, 15 feet wide, filled with stringers and lenses of quartz between mineralized schist. It strikes N. 20° E., and dips 45° NW. It has been followed by a drift for 160 feet northeast along the strike until it was abruptly terminated by a transverse fault dipping 60° SW. Some very rich ore has been mined and milled from shoots in the stringers of this lead.

At the end of the west crosscut a drift was also run for 200 feet to the south along the strike of a 4-inch quartz stringer. Several short crosscuts have been driven to the east and west from this drift, disclosing other small stringers more or less parallel to the drift.

A crosscut was also driven for a distance of 100 feet east from the shaft.

The property is equipped with a mill containing two Nisson stamps. It is situated on Ester Creek a little more than half a mile from the mine.

### ANTIMONY MINES

During the years 1915 and 1916 a number of antimony mines in the Fairbanks district were opened to take advantage of the high price of that metal caused by the exceptional demand for it in connection with the manufacture of war munitions, and nearly 4,000 tons of the ore were shipped to the various purchasers throughout the United States. The most important of these mines were situated on Vault and Little Eldorado Creeks, which are tributaries of Chatanika River; on Chatham Creek, a tributary of Cleary Creek; and on Eva Creek, a tributary of Ester Creek. In 1917, however, the price of antimony declined to a point which no longer furnished a profit after paying mining costs and transportation charges, and hence the antimony mines in this district have since been idle.

### VAULT CREEK

#### Black Eagle Mine.

The Black Eagle mine was the largest producer of antimony ore. It was situated on a small branch of Treasure Creek, which is the west fork of Vault Creek. The property is 4½ miles from the Vault Creek summit on the Chatanika branch of the Alaska Railroad.

The ore occurred in a shear zone ranging from 3 to 10 feet in thickness and having an east-west strike and a dip of 50° to 70° S. The enclosing country rock is schist. The richer portions of the ore were found in shoots or lenses varying from a few feet to 40 or 50 feet in length. A small amount of free gold and some silver accompanied the antimony.

The deposit was mined from an adit following along the strike of the lode. Hand drilling was used and the ore was sorted at the mine before shipment. It was hoisted from the mouth of the adit to the top of the ridge on the south side of Treasure Creek by an inclined tram 3,000 feet long. From this point a wagon road follows the tip of the divide to the railroad. The mine produced approximately 2,500 tons of ore during the two years of its operation.

#### Gilmer Mine.

The Gilmer mine is situated on the east side of Vault Creek, about a quarter of a mile south of the Fredericks mine, which has already been described on page 103 of this report.

The antimony ore at the Gilmer mine occurred as lenses or shoots in a fractured zone ranging from 1 to 5 feet in thickness and striking N. 70° E. with a dip of 60° NW. The property was developed by an inclined shaft about 100 feet deep with drifts and stopes on either side from which several hundred tons of high grade antimony ore were mined.

#### LITTLE ELDORADO CREEK

##### Hindenburt Mine.

The Hindenburt mine is situated on the west side of Little Eldorado Creek, about two miles above the Chatanika branch of the Alaska Railroad.

The workings consisted of a shaft about 25 feet deep from which drifts extended along an ore body trending northeast and southwest and dipping 60° SE. Approximately 200 tons of antimony ore were shipped from this property in 1916.

#### CHATHAM CREEK

##### Chatham Mine.

The Chatham mine is essentially a gold mine and has already been described as such, but in 1916 several tons of antimony ore were mined from a stope 60 feet above the main tunnel at a point 850 feet from the portal. The stibnite occurred in a small vertical vein about 18 inches thick which strikes N. 70° E. It cuts the main vein in the east drift at a point about 150 feet from the tunnel.

#### EVA CREEK

##### Stibnite Lode.

The Stibnite lode is situated at the head of Eva Creek about two miles north of Berry postoffice and seven miles from Ester station on the Alaska Railroad.

The ore occurred as lenses or kidneys of stibnite in a shear zone in the schist country rock. The lode ranged from 1 to 3 feet in thickness and had a strike of N. 30° W. with a steep dip to the north. The gangue mineral was chiefly quartz which was usually stained by alteration products of the stibnite. The mine produced about 100 tons of antimony ore during 1915 and 1916.

#### TUNGSTEN MINES

There was also considerable prospecting and mining of tungsten ores during 1915 and 1916 and 1917, likewise engendered by the high price of that metal due to abnormal war conditions. The work centered in two districts, one near the head of Gilmore Creek and the other near the head of First Chance Creek, both of which are tributaries of Goldstream from the south.

#### GILMORE CREEK

##### Alaska Tungsten Mines Company.

The property of the Alaska Tungsten Mines Company includes the Scheelite and Tungsten claims which are situated on the divide at the head of Gilmore Creek about six miles from Gilmore.

The ore occurs as a disseminated deposit in a mineralized zone following the cleavage of the country rock which is highly metamorphosed and silicated crystalline limestone.

On the Scheelite claim the lode is from 2 to 12 feet thick and strikes N. 70° E. with a dip of 20° to 40° NW. It has been developed by an inclined shaft 150 feet deep, which starts on an angle of 40° but flattens appreciably in depth. Near the bottom the shaft has been widened to a slope which follows the irregular outlines of the ore body which in places attains a breadth of 40 feet. Approximately 400 tons of ore were mined from this claim.

The lode on the Tungsten claim, which adjoins the Scheelite on the east, has a strike of N. 70° E. and a dip of 38° N. It ranges from 4 to 6 feet in thickness and attains a breadth of 10 feet. It was developed by an inclined shaft 75 feet deep, from which approximately 250 tons of ore were mined.

During the first two years of operation the ore was hauled to one of the mills on Fairbanks Creek for treatment, but during 1917 a Faust jig and concentrating table were installed on Yellow Pup, a tributary of Fish Creek, about a mile from the property and at 1,000 feet lower elevation. The mill was operated but a few months, however, before mining ceased because of the drop in the price of tungsten ore.

#### FIRST CHANCE CREEK

##### Tanana Group.

The Tanana group consists of five claims situated at the head of First Chance Creek about two miles from Gilmore.



The principal work on this group consists of a shaft 40 feet deep, which follows a 3-foot mineralized zone having a strike of N. 30° E. and a dip of 35° NW. The scheelite occurs in stringers of soft, decomposed, iron-stained schist 2 to 6 inches thick.

#### Columbia Group.

The Columbia group consists of three claims situated at the head of Steele Creek just over the divide from First Chance Creek and half a mile south of the Tanana group.

The principal development work consists of an adit driven for 80 feet along the granite hanging wall of a vein which strikes N. 20° W. and dips northeast. The vein, which is three feet thick, consists of decayed stringers of country rock impregnated with a small amount of scheelite. A Faust concentrating mill was erected at the property in 1917.

#### Other Properties.

Scheelite has been found at a number of other properties in the vicinity, including the Tungsten Hill Group of eight claims lying a quarter of a mile west of the Tanana Group, the Spruce Hen Group of three claims a quarter of a mile east of the Tanana Group, and the Blossom Group west of the Tungsten Hill.

Work on these properties has been confined to surface trenching and, although in several instances encouraging prospects were found, no appreciable development work was done prior to the drop in the price of tungsten ore, which effectively terminated tungsten mining in the Fairbanks district.

### FUTURE OF GOLD LODE MINING

It is true that the inactivity from 1917 to 1921 has created in some quarters a feeling of skepticism as to the future of lode mining in the Fairbanks district; but even a brief survey of the three reasons for that inactivity, namely, lack of adequate transportation facilities, shortage of fuel, and the high cost of supplies, if made in the light of conditions as they now exist will show that such skepticism is without foundation in fact.

The lack of adequate transportation facilities was caused by the fact that shipments of supplies to Fairbanks could only be made on river steamers with a long haul up the Yukon River from St. Michael or a longer haul downstream from Whitehorse after a costly railroad portage from Skagway, and by the fact that such steamers could operate but four or possibly five months at best during the summer of each year. Hence, not only were freight charges high, but, what is more important, shipments had to be planned at least a year in advance and a much larger stock of supplies had to be carried. This condition has been entirely changed by the completion of the Alaska Railroad, which now operates

bi-weekly trains from Fairbanks to open tidewater at Seward throughout all the twelve months of the year. The shortage of fuel was due to the exhaustion of the available standing timber on most of the important creeks in the district, necessitating longer hauls and a consequently higher price. This has been remedied by the building of a spur from the railroad at Healy to the coal mines at Suntrana, as a result of which fuel for mining operations, the cost of which is one of the big items of expense, is now available at any point on the main line or the Chatanika branch at a much lower cost per horsepower than has ever prevailed during the last 10 or 15 years. And the cost of supplies, although it has not yet reached the pre-war level, is appreciably lower than it was five years ago and is steadily decreasing each year.

In the above descriptions of gold mines and prospects the attempt has been made to include none but those which have either made an appreciable production or show reasonable possibilities of such. There are no large and rich bonanzas in the list, however, and future mining at most of them must be done slowly, carefully and economically by, or at least under the direct personal supervision of, the owners or operators. The outstanding factors in the success of the two mines in the district that were able to operate during the lean years are this direct personal supervision, the elimination of overhead expense, and the postponement of mill construction until fully warranted by the mine development. On the other hand the above list contains several instances where the showing was as good if not better than these two mines but where financial failure was caused by a disproportionately large organization with high overhead expense, or by the investment in a mill or an expensive cross-cut tunnel in advance of adequate delimitation of the ore body. If this past experience is used as a guide to avoid similar errors in the future there is no hesitancy in predicting a steady and sound increase in gold mining activity in the Fairbanks district.

## THE KANTISHNA REGION, ALASKA

By JOHN A. DAVIS

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### INTRODUCTION

#### LOCATION

The Kantishna Region, in the broader sense, includes that portion of Interior Alaska lying between the Tanana River on the north, the crest of the Alaska Range on the south, and the 149th and 152nd meridians on the east and west respectively, and embodies an area of approximately 10,000 square miles.



## DRAINAGE

The main stream within this area is Kantishna River. It is one of the chief tributaries of the Tanana and empties into that stream about 90 miles above the junction with the Yukon. Two of its principal tributaries, Toklat and McKinley Fork, have their headwaters in the Alaska Range and are supplied from the melting ice fields and glaciers on the northern slopes of these mountains. A third tributary, the Bearpaw, does not reach the high mountains but has its headwaters in the Kantishna hills, which lie 15 or 20 miles north of the main range. The eastern portion of the region is drained by Nenana River and its principal tributary from the west, the Teklanika.

## TOPOGRAPHY

The northern part of the region contains the broad, flat lowlands of the Tanana River, which is about 25 miles wide along the Nenana River and increases to 60 miles in width in the western part of the region. In this lowland the surface rises gently from the river to the base of the foothills. It is dotted with lakes and marshes and for the most part is so swampy that travel across it is impossible during the summer months. Flanking the lowlands from the Nenana to the Toklat is a range of foothills. Beyond the Toklat these widen and include the Kantishna hills. A second range of foothills lies south of the first and extends from the Nenana River at the mouth of Healy Fork to the east fork of the Toklat, where it merges with the main Alaska Range. Between the foothills ranges are broad, open valleys having little relation to the present drainage which crosses them at right angles and pierces the foothills in deep, rock-walled canons.

The Alaska Range between Nenana River and Muldrow Glacier is about 20 miles in width and many of the peaks rise to elevations of 7,000 or 8,000 feet. Beyond Muldrow Glacier to the west the peaks become higher, culminating in Mount McKinley, whose summit rises 20,300 feet above sea-level.

## GEOLOGY

The geology of the region has been covered at length by Capps(a) in Bulletin 687 of the U. S. Geological Survey, to which the reader is referred for a more detailed description.

## MINING DISTRICTS

From the view-point of mining development the most important localities in this region are the Kantishna and Copper Mountain districts. The Kantishna district is situated in the southern part of the Kantishna hills and comprises the area drained by Eldorado, Friday,

(a)—The Kantishna Region, Alaska. Stephen R. Capps, Bull. U. S. Geol. Surv., 687, Washington, 1919.

Eureka and Glen Creeks, which flow into Moose Creek, the principal tributary of the Bearpaw River, and by Glacier and Caribou Creeks, which are also tributaries of the Bearpaw. The Copper Mountain district is located on the north slope of the main range near the northern terminus of Muldrow Glacier. In addition some placer mining is carried on at Little Moose Creek, a tributary of Clearwater Fork of the Toklat.

## THE KANTISHNA DISTRICT

## PLACER MINING

Placer gold was first discovered in the Kantishna district in 1905. The diggings were shallow and rich and the news of their discovery caused a stampede of several thousand people, chiefly from the Fairbanks district. But by midwinter it was generally known that bonanza ground was restricted to a few short creeks and by the fall of the following year the population had dwindled to 50 or 60 of the more fortunate who had staked paying claims. The value of placer gold won from this district during the period from 1905 to 1921 is estimated by the U. S. Geological Survey (a) at \$480,000.

With the exception of two large-scale hydraulic operations, the Kantishna Hydraulic Co. and the Mt. McKinley Gold Placers, Inc., placer mining in the Kantishna district is conducted at present by individuals, or by partnerships having not more than two or three members, usually without the employment of any additional labor. Mining is carried on in the narrow V-shaped bottoms of the present creeks, the paystreak being narrow and the depth to bedrock rarely more than 10 or 15 feet. The upper portion of the gravel deposit, together with any surface muck, is customarily removed by "ground sluicing" from an automatic dam, and the lower 2 or 3 feet of gravel containing the concentrated gold from the entire deposit is shoveled by hand into sluice boxes mounted on low trestles and containing riffles for saving the gold. Where the bedrock is "loose" or shattered and broken one or two feet of the top portion is also shoveled in with the gravel.

Various types of riffles are used, depending upon individual preference of the miner, the pole and the Hungarian types being the favorites. The gold is usually coarse and the recovery is therefore relatively high.

The automatic dams are provided with a spillway and a flexible gate. Attached to the gate is a lever having a counterweight and a wooden box which becomes filled with water when the level behind the dam reaches a predetermined height. The weight of this water opens the gate abruptly, loosing a flood through the spillway. When the pond above the dam is emptied, the gate closes and the operation is repeated.

(a)—Alaska Mining Industry in 1921, Alfred H. Brooks, Bull. U. S. Geol. Surv., 739, page 38.

automatically at intervals, depending upon the amount of water flowing down the creek.

During the season of 1922 there were 12 individuals or partnerships engaged in placer mining in the Kantishna district. They were: Peter Liesh on Friday Creek; Weisel and Ferraris at claim 10 above, and Peter Nelson at claim 13 above discovery on Eureka Creek; Faulkner and Appelle on Rainy Creek; Dan Badavinac at claim 6 above, and Dan Keeler at claim 13 above discovery on Glen Creek; Standall and Lilldale on the right fork of Glen Creek; Chas. Trundy on the left fork of Glen Creek; Sutherland and Le Claire on Spruce Creek; John Lee at claim 14 above, and William Sborgia at claim 22 above discovery on Glacier Creek; and Andrew Ness on 22-pup of Glacier Creek.

The largest area of bedrock cleaned at any of these operations was 20,000 square feet, from which approximately \$5,000 was recovered. The other operations were much smaller than this, ranging from 1,500 to 4,000 square feet with recoveries of \$300 to \$1,000.

#### Kantishna Hydraulic Mining Co.

The Kantishna Hydraulic Mining Co. owns approximately 890 acres of placer ground on Moose Creek, embraced in 45 claims, extending from a short distance above Eureka Creek to  $1\frac{1}{2}$  miles below Friday Creek. The claims were located at various times from 1905 to 1920 and none are patented.

Moose Creek is one of the larger tributaries of Bearpaw River and has a gradient of 227 feet in three miles at the property. Its valley is 2,000 to 2,500 feet in width and the sides are abrupt. The creek flows through a narrow canon about two miles above Eureka Creek and there is a second canon at the lower end of the property. Water for hydraulic operations can be had from Moose Creek, which carries from 1,500 to 3,000 miners' inches, and from Wonder Lake, the outlet of which joins Moose Creek  $1\frac{1}{2}$  miles above the property. This lake is about  $3\frac{1}{2}$  square miles in area, and the water is impounded by a dam five feet high. It is believed that the lake derives its water chiefly from underground seepage. An additional 5,000 or 6,000 miners' inches could be brought to Wonder Lake from McKinley Fork at an estimated cost of \$125,000. It would, however, have to be taken from within the boundaries of Mt. McKinley National Park.

The property is underlain by a false bedrock at a depth of eight feet below the bottom of the creek. The distance to true bedrock is not known, although a shaft which was drowned out at a depth of 30 feet is thought to have been very close to it. The paystreak is from 400 to 600 feet in width, the value of which preliminary estimates placed at fifty cents per square foot. Gravels of lower value which, it is estimated, carry from eight cents to ten cents per square foot extend beyond this on either side. Some gold is found distributed all through the gravel, although the richer ground is found near the false bedrock. Large boulders are rare, the maximum being 400 or 500 pounds.

Preparatory work at this project included the construction of a dam at the outlet of Wonder Lake, a ditch 12,000 feet long, two to six feet deep, five and a half to six feet wide at the bottom and six to eight feet wide at the top, and an inverted siphon across Willow Creek 268 feet long, 41 feet high on the intake and 31 feet high on the discharge end.

The pipe line consists of 4,000 feet of riveted steel pipe tapering from 26 inches to 18 inches in diameter, together with 1,300 feet of side lines and feeders tapering from 14 inches to 9 inches in diameter. There are 5 giants, using 3,  $3\frac{1}{2}$  and 4-inch nozzles interchangeably. The effective head is 238 feet.

The cost of the claims is reported at \$33,000; the dam \$300; the ditch, including the trestle for the siphon, \$9,700; and the pipe lines, including the siphon, \$19,500.

Approximately 50,000 square feet of bedrock were cleaned during 1922, which was the first season of operation at this property. The gravel was piped over the side of the sluice boxes, which were 30 inches wide, 20 inches deep and had a slope of 9 inches in 12 feet. The upper boxes of the string were fitted with riffles made of iron boiler tubes and the lower boxes had iron plates perforated with  $\frac{3}{4}$ -inch holes. The gold recovery was disappointing as it fell considerably below the estimated value of the ground.

The mining method employed at this property is further described by Norman L. Wimmeler, whose account is given herewith:

The creek deposit mined is practically all thawed and averages 10 ft. in depth, there being about 2 feet of moss and soil and 8 feet of medium sized gravel. This gravel rests upon a "false bedrock" of clay. This clay has been found to be from 10 to 15 ft. thick and to be underlain by about 25 ft. of gravel, which will be prospected. Bedrock is very flat and a method of "piping in" over the side is used.

This method, as described to me by Mr. J. Howell, is in general as follows:

A giant is set up and a cut made across the channel sufficiently large and at a grade so that from 9 to 10 lengths of 40-inch boxes can be set at a grade of 9 inches to the box. As a rule the head of the boxes is about 20 inches below the surface of the ground, the lower end being a foot or so above bedrock. These boxes are heavily built out of 2x10 lumber with liners of similar size and the portion exposed to battering of the gravel and water is reinforced and protected. A heavy board apron extending 7 ft. or more above the top of the boxes is constructed on the upstream side and set at a high angle so that gravel driven against it will fall into the boxes. An 8x8-inch timber is bolted lengthwise along the apron at a sufficient height to keep the gravel from falling behind the boxes and also to serve as a protection to the edge of the box.

Two giants are set from 200 to 250 feet downstream from this line of boxes so that each giant can cover its field to the best advantage. A third giant is placed so that it can pipe material into the field of the middle giant and also stack the tailing. The material is then piped

upstream or against the slight grade, but is piped into the boxes well toward the head so as to allow sufficient riffle area for good gold saving. As the gravel is driven towards the boxes, the bedrock is piped clean, the boulders being piled to one side, and giants are moved forward if necessary. When a cut is finished to the boxes, they are cleaned up and pulled to one side. The giants are then brought up and operations continued to the next set of boxes, already placed about 200 feet farther upstream. The method is well adapted to the shallower gravel deposits where but little grade is available. A good supply of water under fairly high head is necessary to move sufficient gravel. There is very little time lost. As some of the giant water does not reach the boxes a good supply of water must be turned into the head of the boxes. Seven men are employed each shift of 8 hours. Wages paid are \$5.00 and board. In 62 8-hour shifts, 50,000 sq. ft. of gravel averaging 10 feet in depth was handled by this system.

#### Mount McKinley Gold Placers, Inc.

The Mount McKinley Gold Placers, Inc., owns all the claims on Caribou Creek from the mouth to one mile above Crevice Creek; all the first tier, left limit, bench claims on Glacier Creek from discovery to 14 above; and approximately 400 acres on the divide between Glacier and Caribou Creeks. The claims were located at various times from 1905 to 1920 and none are patented.

Caribou Creek has its headwaters on the north and west slopes of Kankone Peak in the Kantishna hills and flows west for approximately ten miles, then north for seven or eight miles, emptying into the Bearpaw near the town of Glacier. On its westerly course it is joined at intervals of one to two miles by Crevice, Last Chance, Snowshoe and Rex Creeks in the order named, all of them flowing into the main creek from the south. After Caribou Creek turns to the north it has no important tributaries from either side.

Glacier Creek has its headwaters on the north and west slopes of Glacier Peak, which is situated about five miles southwest of Kankone Peak, flowing west for two or three miles and then north for ten miles, emptying into the Bearpaw near the mouth of Caribou Creek. The distance between Glacier and Caribou Creeks varies from two to three miles.

The gradient of Caribou Creek at the upper end of the property is approximately 150 feet per mile, but after it turns to the north the gradient is about 75 feet to the mile. The valley floor averages 1,500 feet in width and in the upper portion of the creek the valley walls are steep and abrupt, somewhat more so on the right limit than on the left, but where the stream flows on a northerly course the sides are low and equally gently sloping. There are three canons or constructions in the valley of the creek, one near the center of the property, one at Rex Creek and one at Last Chance Creek.

Water for hydraulic operations is taken from Caribou Creek, which has a flow of perhaps 100 cubic feet per second in wet seasons and 25 cubic feet per second in dry seasons, the average being 50 cubic feet per second.

The depth to bedrock in Caribou Creek varies from two feet at the head to twelve or fourteen feet near the mouth. On the benches the depth is unknown; two holes on the Glacier Creek side failed to reach bedrock at 46 and 52 feet respectively. The paystreak is not well defined and the deposit is spotty. The value of gold near the mouth of Snowshoe Creek is estimated at seventy-five cents per cubic yard in the center of the deposit, with some 20c and 25c ground on either side. Seventy-five per cent of the values are found at or near the surface of bedrock. Boulders as large as one cubic yard are frequently met with and are a serious handicap to mining operations.

The hydraulic plant includes 450 feet of ditch, 460 feet of flume which is 4 feet wide and 2 feet deep, and 4,000 feet of riveted steel pipe tapering from 36 inches to 9 inches in diameter. The dam at the intake near Crevice Creek is 200 feet long and 8 feet high. Three nozzles are used, two being 4 inches and the other 5 inches in diameter. The smaller ones are used for driving and the larger for stacking tailing. The effective head at Rex Creek is 150 feet.

The cost of the claims is reported to average \$500 per 20-acre claim. The pipe line and nozzles cost \$22,000 in Seattle and weigh 77 tons. Figures for the cost of the dams and flume were not available.

During 1922, which was the first season of operation, approximately 70,000 square feet of bedrock were uncovered. The gravel was piped into the end of the boxes, which were 4 feet wide and 3 feet deep and had a slope of 4 inches in 12 feet. Cottonwood block riffles were used. The low gradient of the boxes, although it was the maximum obtainable, caused great difficulty in mining. As a result preparations were being made at the end of the season to pipe the gravel over the side of the boxes during the coming year and obviate this trouble. No data could be obtained as to the amount of gold recovered except that it was somewhat disappointing.

### LODE MINING

Lode mining development in the Kantishna district centers in Quigley Hill, (a) as the main ridge between Friday and Eureka Creeks has been named in honor of Joseph B. Quigley, the pioneer "quartz" prospector of the district. The mineralized zone found in this hill has been traced beyond Glacier Peak to the east, a distance of 8 or 10 miles, and for about 5 miles to the southwest across Moose Creek along the divide between Eldorado Creek and Bear Creek.

(a)—Note: The positions of the claims on Quigley Hill are indicated on the accompanying sketch map—Plate I.

## QUIGLEY HILL

## Red Top Claim.

One of the most important claims on Quigley Hill is the Red Top, which lies across a spur that slopes toward the mouth of Friday Creek from the western end of the hill. The claim trends N. 70° E., and its center lies along the crest of the spur; the western half extends down a steep slope toward Moose Creek and the eastern half extends along the more gentle slope of Friday Creek valley.

The vein on the Red Top claim occupies a fault fissure in a country rock of Birch Creek schist. It ranges from 4 to 10 feet in width, the vein matter being chiefly quartz with shoots containing galena, zinc blende, arsenopyrite and occasionally tetrahedrite, together with the oxidation products of these minerals. The hanging wall is quite distinct and both slickensides and gouge are present. The reverse is usually true in regard to the foot wall and shows replacement of the schist by vein matter. The sulphides, particularly those of lead and copper, carry a high silver content and some gold. They are usually segregated in a band or seam varying in width from 5 or 6 inches to as much as 3 feet, and at some places are found near the hanging wall and at others near the foot wall of the vein. Where weathered the quartz is stained with oxides of iron and often contains free gold which may be detected by panning.

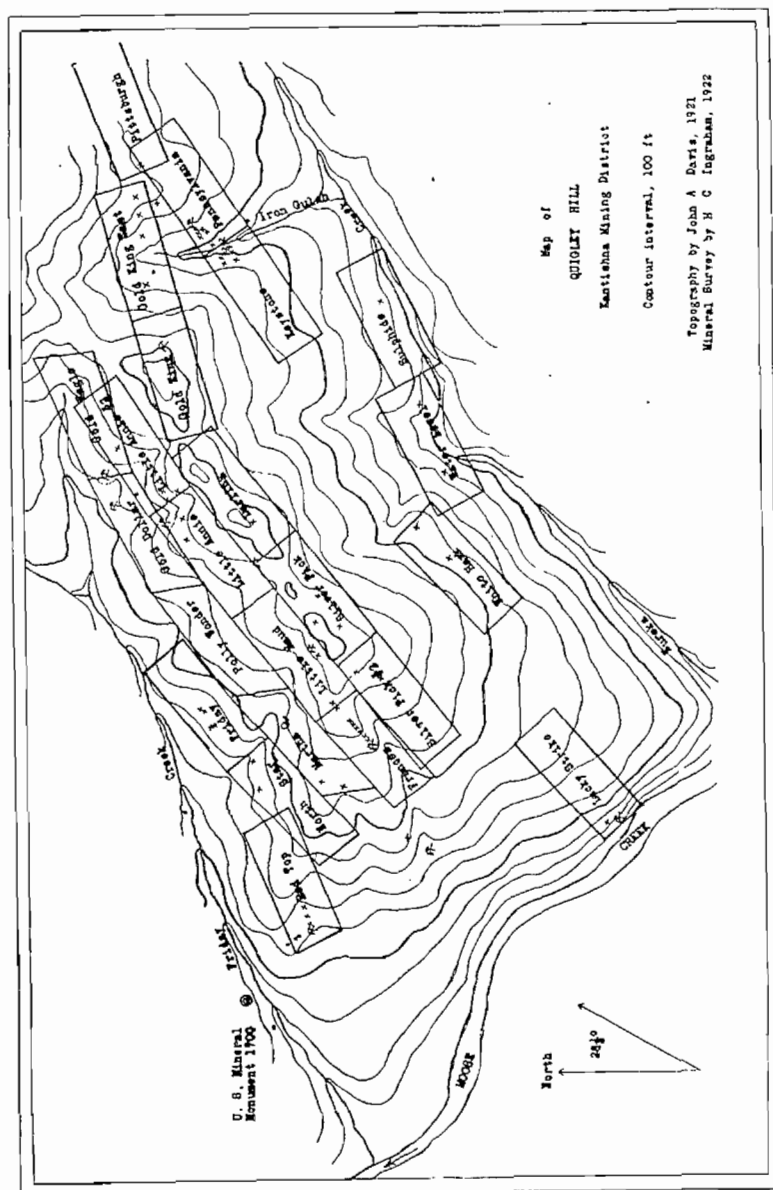
At the time the claim was visited by the writer in September, 1922, the development work consisted of a series of open cuts and a tunnel 300 feet long. The open cuts extend southwesterly along the outcrop of the vein from the discovery stake, which is situated about half way up the steep slope mentioned above. The tunnel near the bottom of the slope starts at a point about 150 feet from the west end line of the claim.

The discovery cut disclosed something over nine feet of vein matter, although the full width may not have been exposed. The vein consisted of two bands of mineralized quartz each about three feet in width, separated by a band of practically solid galena and oxidized products of galena also about three feet in thickness. A sample taken by the writer across the galena bearing portion assayed 0.28 ounce of gold, 57.6 ounces of silver, and 12.8 percent lead. The quartz portion also carries some gold and silver.

A second open cut, 50 feet southwesterly from discovery shows four feet of galena or its oxidization products. An interesting feature of this open cut is the occurrence of a considerable amount of what is apparently free sulphur, which will ignite with a match and burn with a characteristic blue flame and odor.

A third cut, 80 feet southwesterly from discovery, shows vein matter in place, but at the time of the visit it had caved in so that it was inaccessible.

A fourth cut, about 150 feet from discovery, was also inaccessible, but a fifth cut, at 220 feet, showed 15 inches of galena which is said to have



assayed \$275 per ton in combined gold and silver. The full width of the vein could not be determined at this point.

The Red Top tunnel starts at a point 255 feet S. 75° W. from the discovery stake and follows a somewhat irregular course, the general trend of which is north of east, for a distance of approximately 300 feet.

Thirty-seven samples were taken by the writer from the untimbered portion of the Red Top tunnel. Eight samples from the timbered portion, which includes the first 67 feet of the tunnel, were taken by Mr. Quigley at the time the timbering was placed. The assay returns of these samples, which are lettered A to H, inclusive, to distinguish them from the numbered samples taken by the writer, are given here because they indicate the values in a portion of the tunnel which could not be sampled at the time the mine was examined. All assays were made at the Alaska station of the U. S. Bureau of Mines.

The following table shows the results of the assay of these samples:

ASSAYS OF SAMPLES FROM RED TOP TUNNEL

Sample	Width Sample	Distance from Portal of Tunnel	Ounces per ton Gold	Silver	Total Value (See note below)
A	3.0 feet	10 feet	1.66	1717.10	\$1755.55
B	3.0 feet	15 feet	1.94	828.60	868.70
C	3.0 feet	20 feet	1.72	632.30	667.85
D	3.0 feet	25 feet	1.28	661.20	687.66
E	3.0 feet	30 feet	0.58	689.00	699.99
F	3.0 feet	35 feet	1.96	735.70	776.21
G	3.0 feet	45 feet	0.80	237.70	254.24
H	3.0 feet	55 feet	0.14	0.10	2.99
1	2.0 feet	65 feet	0.06	0.20	1.44
2	2.0 feet	80 feet	trace	0.60	0.60
3	0.7 feet	80 feet	0.20	80.60	84.73
4	1.8 feet	90 feet	0.08	1.20	2.85
5	2.5 feet	100 feet	0.06	0.40	1.64
6	1.7 feet	110 feet	0.10	0.20	2.27
7	0.8 feet	110 feet	0.04	0.20	1.03
8	1.5 feet	120 feet	0.24	0.80	5.76
9	1.8 feet	120 feet	trace	0.10	0.10
10	2.0 feet	130 feet	0.08	0.40	2.05
11	2.0 feet	140 feet	0.15	0.60	3.70
12	1.0 feet	150 feet	0.09	0.60	2.46
13	2.5 feet	In c.c. at 160	0.12	44.60	47.08
14	4.0 feet	160 feet	trace	0.20	0.20
15	5.0 feet	In c.c. at 160	0.20	0.40	4.53
16	5.0 feet	In c.c. at 160	0.18	0.30	4.02
17	5.0 feet	In c.c. at 160	0.06	0.20	1.44
18	5.0 feet	In c.c. at 160	0.04	0.20	1.03
19	3.5 feet	In c.c. at 160	0.04	0.20	1.03
20	3.0 feet	170 feet	0.36	1.20	8.64
21	3.7 feet	180 feet	0.28	11.30	17.09
22	1.0 feet	190 feet	0.14	6.20	9.09
23	2.5 feet	In c.c. at 195	1.74	6.40	42.37
24	2.0 feet	200 feet	0.08	1.20	2.85
25	0.7 feet	In winze at 205	0.04	0.10	0.93
26	3.0 feet	In winze at 205	0.12	10.50	12.98
27	3.7 feet	210 feet	0.06	1.60	2.84
28	3.0 feet	220 feet	0.14	2.40	5.29
29	3.3 feet	230 feet	0.16	13.50	16.81
30	2.9 feet	240 feet	0.44	6.00	15.10
31	2.8 feet	250 feet	0.14	1.40	4.29
32	2.5 feet	260 feet	0.24	3.50	8.46
33	4.0 feet	In c.c. at 260	0.10	0.20	2.27
34	4.0 feet	In c.c. at 260	0.04	0.10	0.93
35	4.0 feet	In c.c. at 260	trace	0.10	0.10
36	3.0 feet	270 feet	0.44	1.30	10.40
37	5.0 feet	280 feet	0.52	1.60	12.35

Note: Calculated on the basis of gold at \$20.67 per ounce and silver at \$1 per ounce.

Approximately five tons of high grade ore, secured while driving the first 50 feet of the tunnel, had been sorted and sacked for shipment and the dump contains approximately 600 tons, which it is estimated has a value of \$15 to \$20 per ton. A grab sample of the sacked ore, taken by Mr. Livingstone Wernecke, and assayed at Juneau, showed 1.24 oz. of gold and 243.1 oz. of silver per ton.

In September, 1922, Mr. Hawley Sterling of Fairbanks obtained a lease to mine the high grade ore shoot near the portal of the tunnel and on January 1, 1923, had taken out approximately 50 tons of ore believed to average over \$200 per ton. The ore mined under the lease will be hauled to the Alaska Railroad at Kobe (Mile 387) and shipped to the smelter by way of Seward.

#### Hillside or Silver King Claim.

An extension of the Red Top claim has been located to the west along the bench above Moose Creek. The Red Top vein was exposed in the bottom of a 40-ft. shaft which was sunk just beyond the west end line of the Red Top claim. The vein at this point was from 5 to 6 feet wide and carries sulphides of lead and copper in a quartz gangue.

The ownership of this ground is at present in litigation, one of the claimants calling it the Hillside and the other claimant the Silver King.

What is thought to be a further extension of the Red Top ledge was exposed in 1921 in an open cut made by ground sluicing on the steep hillside above Moose Creek on the opposite side from the Red Top claim. At the time the district was visited by the writer a slide of debris, loosened by the water used in ground sluicing, had completely refilled the cut, making it impossible to secure any detailed data as to this exposure.

#### Galena Claim.

The Galena claim lies along the western end of Quigley Hill, about 2,000 feet south of the Red Top, and is adjoined by the Frances claim on the east. The principal developments on this claim are a tunnel near the discovery stake and an open cut about 300 feet to the northeast.

The tunnel is driven through schist country rock for a distance of 30 feet until it intersects a vein which it follows for 30 feet. The vein is 8 or 9 feet wide, consisting chiefly of highly iron-stained quartz, which contains galena, arsenopyrite, zinc blende, and some tetrahedrite. These sulphides occur in a band about 12 inches thick near the hanging wall, which is well defined. The foot wall, however, gradually merges into the schist country rock. The strike of the vein is approximately N. 45° E., the dip 65°-70° S.E. A shallow winze a few feet from the breast was inaccessible at the time this claim was visited.

The open cut lying northeast of the tunnel shows a quartz vein about a foot in width containing tetrahedrite and chalcopryite. The strike of this vein is N. 45° E. with a nearly vertical dip. Between 50 and 100 tons of ore derived partly from the tunnel and partly from the open cut have been mined and shipped to the smelter at Selby, California.

**Lucky Strike Claim.**

Two veins have been discovered on the Lucky Strike claim in the bluff overlooking Moose Creek. A tunnel has been driven along the strike of one of these veins which is N. 59° E. The vein, which dips 84° S., is exposed for 20 feet above the tunnel and shows at least 6 feet of quartz between schist walls. The hanging wall is highly silicified. A sample of this vein next the foot wall, consisting of highly mineralized quartz and thought to be the richest portion, shows .04 ounces of gold and 6.40 ounces of silver per ton. A sample of the next 3 feet of the vein shows .05 ounces of gold and 10.00 ounces of silver per ton. The vein is reported to carry valuable minerals beyond this width but a sample could not be obtained.

The second vein has been exposed in two open cuts about 40 feet apart and lying 125 feet north of the tunnel just mentioned. They show a strong quartz vein, well mineralized, and probably about 8 feet wide, although the cuts were so badly caved that the width could not be accurately determined, nor could a representative sample be secured. A number of pieces of vein matter that were broken off at random assayed .04 ounces of gold and 1.10 ounces per ton in silver. The samples were taken by Mr. John Gross, metallurgist of the Bureau of Mines.

**Silver Pick No. 2 Claim.**

At discovery, on the Silver Pick No. 2 claim, which is 400 feet from the east end of the claim, a shaft 12 feet deep showed 6 or 7 feet of iron-stained quartz and calcite. The shaft was caved at the time of the visit and no samples were taken for assay.

An open cut near the northeast corner of the claim showed 3 feet of iron-stained quartz. A sample taken by Mr. Gross at this point assayed .14 oz. of gold and .10 oz. of silver per ton. The strike of the vein is N. 88° E. and the dip 63° N.

**Frances Claim.**

Development on the Frances claim consists of a tunnel 75 feet in length, the first 40 feet of which is timbered, and a series of open cuts on the surface extending along the strike of the vein which is N. 55° E. As exposed in the tunnel the vein varies from 12 to 40 inches in width. It dips to the south at an angle of 65°. The vein matter in the tunnel is chiefly white quartz carrying gold and silver, but at discovery cut, near the east end line of the claim, some copper sulphide was observed. The open cuts were filled with material which had caved from the sides, hence no information could be obtained about the vein other than that indicated by the small dumps produced when the cuts were excavated. A series of samples taken by Mr. Gross across the total width of the vein at five-foot intervals in the tunnel gave the following assays:

Sample Number	Ounces per ton	
	Gold	Silver
1	.02	.50
2	.01	.10
3	trace	.20
4	.06	1.00

The value of the ore in the Frances tunnel appears to vary greatly from place to place, however, and samples taken by the lessee of this property in 1919-20 gave much better returns than this, some of them running as high as \$35 per ton in gold and silver.

**Martha Q. Claim.**

A shallow shaft near the northwest corner of the Martha Q. claim has exposed a narrow vein, consisting chiefly of galena, having a strike of N. 15° W. and a dip of 56° E. A sample taken by Mr. Gross across 6 inches of this vein assayed .08 oz. in gold and 284.20 oz. in silver per ton. Several tons of ore were shipped from this claim in 1920-21, being added to the ore from the Gold Dollar claim, which is described below.

**North Star Claim.**

An open cut in the southwestern part of the North Star claim disclosed a 6-inch stringer containing galena and zinc blende from which a sample is reported to have assayed 60 ounces per ton in silver.

**Friday Claim.**

Development work on the Friday consists of a number of open cuts which were excavated in an effort to discover an extension of the Red Top vein. Although encouragement has been received from the finding of rich float in the debris of the hill, solid bed-rock was not reached in any of these cuts.

**Polly Wonder Claim.**

An open cut on the Polly Wonder claim 100 feet southwest of discovery exposed 8 feet of iron-stained quartz in which free gold can be detected by panning. The ore also contains a small amount of galena. The strike is approximately due east with a dip of 65° or 70° to the south.

**Little Maud Claim.**

At discovery, on the Little Maud claim, which is near the west end line and but a few feet from the discovery on the Frances, the open cut showed a quartz vein 18 inches wide, carrying some tetrahedrite. The strike of the vein is approximately N. 55° E. with a dip to the south of 60° or 70°.

**Silver Pick Claim.**

The Silver Pick claim is developed by a number of open cuts and by a cross-cut tunnel 190 feet long which starts on the Little Maud claim. The first 25 feet of the tunnel is timbered and its course is S. 30° E. It intersects three veins, the first directly at the portal, the second at a distance of 55 feet and the third at a distance of 165 feet.

The first vein, which is composed chiefly of quartz carrying free gold and some galena, is also exposed in an open cut 100 feet southwest



of the tunnel. It is 3 feet in width. The strike is N. 50° E. and the dip 70° S. A sample taken in the tunnel by Mr. Gross showed .03 oz. of gold and 5.70 oz. of silver per ton.

The second vein shows 6 feet in thickness where it crossed the tunnel on a strike of N. 30° E. with a dip of 65° N.W. The vein matter consists of rusty quartz containing numerous bunches of galena, some pyrite and a considerable amount of zinc blende. According to Capps (a) a picked sample of the galena assayed 100 oz. of silver per ton. A sample taken by Mr. Gross across 6 feet of the vein along the north wall of the tunnel shows .06 oz. of gold and 10.00 of silver per ton. This vein is also exposed in an open cut 125 feet south of the tunnel portal.

The third vein, as described by Capps (a) "consists of one foot of calcite on the footwall and 12 feet of quartz and schist, more or less sheeted, the quartz predominating in bulk over the country rock. Little galena is seen in the tunnel, but it is abundant along the surface crop of the vein. The whole zone is brecciated and leached, and large open cracks extend from the tunnel to the surface. Pyrite, arsenopyrite, and small amounts of galena and sphalerite were observed, and along some of the cracks deposits of a soluble salt, which on analysis proved to be the iron sulphate melanterite, were found." A sample taken by Mr. Gross across 12 feet of the vein along the south wall assayed .05 oz. of gold and .10 oz. of silver per ton. It is quite likely, however, that this sample is not representative, because there are unquestionable evidences of leaching at the point where the sample was taken. The strike of the vein as determined by survey between its exposure in the tunnel and in an open cut on the top of the hill 200 feet distant is N. 65° E. The dip, measured in the tunnel, is S. 67° E.

#### Darling Claim.

The discovery cut, near the center of the Darling claim, disclosed a ledge of iron-stained quartz one foot wide, in which a small amount of pyrite was observed. It is quite probable that the large vein exposed in the Silver Pick tunnel crosses the Darling claim but the work on this claim has as yet failed to expose it.

#### Little Annie Claim.

On the Little Annie claim an open cut on the crest of a spur jutting out from the main hill towards Friday Creek discloses a vein of quartz 13 feet wide, having a strike of N. 58° E. and a steep dip to the SE. The ore for the most part is free-milling and strongly oxidized, although some galena was noted near the hanging wall of the vein. Slickensides indicating a horizontal movement along the strike were observed. A sample taken by Mr. Gross across the full width of the vein assayed 0.28 oz. of gold and 4.90 oz. of silver per ton.

(a)—The Kantishna Region, Alaska, Stephen R. Capps, Bull. U. S. Geol. Surv. 687, Washington, 1919, page 105.  
(a)—The Kantishna Region, Alaska, Stephen R. Capps, Bull. U. S. Geol. Surv. 687, page 105, Washington, 1919.

The same vein is also exposed in a second cut 60 feet southwest and a sample taken by the writer across 10 feet of ledge matter at this point assayed 0.24 oz. of gold per ton and 7.00 of silver per ton.

The principal development work on this claim centers around the Little Annie tunnel which was driven through schist country rock along a course of S. 40° W. to intersect this vein, starting from the west side of a small gulch in the northeast corner of the claim. It is timbered for the first 35 feet. In the tunnel the large vein just described is apparently split into two fairly well defined smaller ones which stand roughly parallel at a distance of 30 feet from center to center. The first of these, which was encountered at a point 60 feet from the portal of the tunnel, is 3 feet 2 inches thick and has a strike of N. 55° E. and a dip of 62° SE. The vein material is iron-stained quartz. A drift extends along the strike of this vein to the southwest for 10 feet and a sample taken by Mr. Gross across the vein at the end of this drift assayed 0.07 oz. of gold and 0.10 oz. of silver per ton. The second vein, which is cut by the tunnel at a point 90 feet from the portal, is 4 feet, 6 inches thick and has a strike of N. 59° E. and a dip of 66° SE. A sample taken on the left wall of the tunnel yielded 0.20 oz. of gold and 0.60 oz. of silver per ton. A drift has been driven along this vein for 75 feet to the southwest. The combined material from cuts taken in the roof of the drift at points 10, 20, 30 and 40 feet from the tunnel and across the full width of the vein in each case assayed 0.08 oz. of gold and 0.50 oz. of silver per ton. The material between these veins is highly silicified schist, intricately dissected by small quartz veinlets, carrying a small amount of gold.

From the point of its intersection with this second vein the main tunnel was extended for 170 feet in a southeasterly direction and it was used during 1919 in mining the high grade ore from a small vein which it intersected at this point.

This small vein consisted principally of silver bearing galena and was traced for nearly 100 feet along the surface by four open cuts. A series of samples taken by Mr. Gross across the full width of the vein in each instance gave the following assay returns:

#### ASSAYS FROM THE OUTCROP OF THE "GALENA VEIN"

Location of Sample	Width of vein sampled	Ounces per ton		Per cent Lead
		Gold	Silver	
Uppermost cut .....	24 in.	0.26	286.20	48.70
Second cut .....	8 in.	0.22	224.00	26.10
Third cut .....	12 in.	0.54	243.80	46.70
Lowermost cut .....	26 in.	0.14	218.90	53.40

During 1919 this claim was operated by a lessee and approximately 500 tons of high grade ore, which averaged over \$200 per ton, were mined and shipped to the smelter at Selby, California. In this work it was discovered that the high grade values rarely continued to a depth of more than 60 feet from the surface. All the ore in this particular shoot having a value greater than \$150 per ton was removed, and the workings were then abandoned. By 1921, when they were first visited by the writer, they had become inaccessible.



The strike of this vein is approximately N. 20° E. with a dip of 65° or 70° SE. The ore is described as being almost solid galena, although some zinc blende and a little gray copper ore were associated with it. The gangue matter when present was either iron carbonate or calcite. Several small faults in a practically vertical plane having a throw of perhaps 5 or 6 feet were encountered during the mining operations.

#### Little Annie No. 2 Claim.

The development on this claim consists of three open cuts. One of them, lying about 100 feet east of discovery, which is situated near the west end line of the claim, disclosed a vein of quartz about 9 feet wide which is highly iron-stained and contains some partly oxidized galena. Free gold can be detected by panning. The strike of this vein is approximately N. 65° E., with a dip of 70° S., and it is believed to be a continuation of the second branch of the Little Annie vein encountered in the Little Annie tunnel. A second open cut, 135 feet south of discovery, disclosed a 12-inch vein containing 5 or 6 inches of practically solid galena having a strike of N. 50° E. with a dip of 65° SE. The galena carries high values in silver and a sample taken by Mr. Gross across 12 inches of the vein assayed .08 oz. in gold and 136.50 oz. in silver per ton. The lessee mined approximately 10 tons of high grade ore from this vein in 1920 having a value of \$200 per ton.

A third cut 800 feet northeast of discovery disclosed a vein of quartz 10 to 12 feet wide which is highly iron stained and contains a considerable amount of oxidized galena. The cut was partly caved and the strike of the vein difficult to determine, but it is approximately N. 60° E., dipping steeply to the southeast. The vein might well be a continuation of the first branch of the Little Annie vein encountered in the Little Annie tunnel. A sample taken by the writer across 10 feet of vein matter assayed 0.10 oz. in gold and 1.00 oz. in silver.

#### Gold Dollar Claim.

A rich shoot of ore was discovered in an open cut near the east end line of the Gold Dollar claim. The vein averages 3 or 4 feet in width and contains galena, sphalerite, tetrahedrite and some stromerite. The strike of the vein is N. 65° E., dipping 75° to the south. It was developed by a shaft 38 feet deep and a short tunnel driven from the side of a small draw to intersect the foot wall of the shaft. During 1920 the lessee mined between 500 and 600 tons of ore from this shoot having a minimum value of \$170 per ton. At the time it was visited by the writer, however, the workings were so badly caved that they were inaccessible.

#### Gold Eagle Claim.

At discovery cut, near the west end line of the Gold Eagle claim, a vein approximately 3 feet wide was disclosed containing galena, pyrite, sphalerite and the oxidization products of these minerals. The sulphides carry high values in silver. A tunnel was started on the east side of

the small draw previously mentioned to intersect this vein and follows a crushed and slicken sided zone for 60 feet along a course N. 70° E. It then swings to the north for an additional 60 feet where it intersects the vein and follows it for 30 or 40 feet along a course N. 65° E. The vein dips 75° SE. The vein in the tunnel, which is chiefly quartz, does not contain as many sulphides as are found in the surface cut. In the tunnel these are confined to a band 8 or 10 inches wide near the foot wall. Three or four tons of high grade ore, valued at \$170 per ton, were mined from the surface cut by the lessee in 1920.

#### Gold King Claim.

The Gold King claim is developed by two tunnels which were inaccessible. As described by Capps (a) the vein has a width of from 4 to 6 feet and strikes No. 80° E. It consists chiefly of quartz containing arsenopyrite, sphalerite and galena.

#### Gold King East Claim.

The vein has been traced across the entire length of the Gold King East claim by a series of open cuts which, however, were so badly caved that no accurate determinations of the width of the vein could be made.

#### Pittsburgh Claim.

At discovery near the west end line of the Pittsburgh claim an open cut disclosed a vein consisting of 6 or 7 feet of quartz containing some sulphides and calcite. The hole was inaccessible, however, and no samples were secured.

#### Pennsylvania Claim.

There are two principal veins on the Pennsylvania claim which have been named Pennsylvania and Keystone by the owner.

The Pennsylvania vein crosses the west end line of the claim, (which lies at the bottom of Iron Gulch) about 100 feet north of the center and extends up the east slope towards the Pittsburgh claim. The strike of the vein is N. 65° E. with a dip of 85° S. and it has been traced for over 500 feet by a series of open cuts spaced at approximately 100 feet intervals. Although there is a gap of about 1,000 feet which has not been prospected as yet, hence the continuity is not absolutely established, it is quite likely that this vein is the same one that is exposed in the discovery cut on the Pittsburgh claim. The vein matter is quartz containing some pyrite and calcite, and free gold can be panned from samples taken along the outcrop.

The Keystone vein crosses the west end line of the claim at a point 100 feet south of the Pennsylvania vein. It has a strike of N. 50° E. with a dip of 60° S. and extends up the hill towards the NE. corner of claim, intersecting the Pennsylvania vein about 400 feet from the west

(a)—The Kantishna Region, Alaska, Stephen R. Capps, Bull. U. S. Geol. Surv. 687, page 103, Washington, 1919.

end line. It has been traced along the surface for more than 1,200 feet by 20 open cuts on the outcrop. The vein matter is chiefly quartz containing a considerable quantity of pyrite and arsenopyrite and some sphalerite and galena. It varies from 4 to 6 feet in width. A tunnel starting near the western end line of the claim has been driven for 50 feet along the hanging wall of the vein, and a shaft was sunk to a depth of 30 feet at a point near the intersection with the Pennsylvania vein. A sample taken by Mr. Gross across 14 inches of vein matter in the face of the tunnel assayed 1.6 oz. of gold and 1.60 oz. of silver per ton. Several ounces of finely crystallized gold were obtained by panning in a small open cut 60 feet east of the portal of the tunnel. A sample taken in the shaft by the writer gave the following assay: Gold, 0.96 oz. per ton, and silver, 0.26 oz. per ton.

#### Keystone Claim.

Both the Keystone and Pennsylvania veins have been traced by open cuts for 300 or 400 feet on this claim. There is a third vein which outcrops near the east end line of the claim between the other two veins and intersects both of them. The strike of this vein is N. 30° E. and it has a steep dip. It is developed by a tunnel which is 50 feet long and by several open cuts on the surface. The vein matter is quartz carrying galena and some pyrite. The vein is 3 feet wide at the portal of the tunnel but narrows to 12 inches at the face. Some of the assays of weathered quartz taken from the surface cuts show high values in gold while others show but a trace, indicating that the deposit is extremely "spotty."

#### Sulphide Claim.

The discovery cut, near the center of the Sulphide claim, disclosed an 8-ft. quartz vein carrying pyrite. It shows free gold on panning.

#### Water Level Claim.

A cut at the eastern end of the Water Level claim disclosed a vein 3 feet in width carrying galena. Samples from this cut are reported to have assayed from 30 to 40 oz. of silver per ton.

#### White Hawk Claim.

A 3-ft. vein carrying some tetrahedrite but no galena was exposed in the discovery cut on the White Hawk claim. This vein has been traced 500 feet to the southwest where a 12-ft. shaft disclosed a 3-ft. vein, which was followed by a drift 15 feet long. The ore is similar to that found at discovery. No assays have been made of samples from this claim.

#### Other Claims.

In addition to these claims there are a number of others, including the Jumbo, Caribou, Meadowbrook, Bluebell, Iron Gulch, etc., which have been staked on Quigley Hill. At the time this district was visited by

the writer the excavations on these claims were so badly filled by caving that no data could be obtained regarding the veins exposed in them.

### ELDORADO CREEK

A number of claims have been staked on the hill north of Eldorado Creek and west of Moose Creek, and in line with the trend of mineralization on Quigley Hill. On the majority of these claims the development work is limited to open cuts on the surface which were inaccessible through caving at the time the district was visited. On the Alpha claim, however, a considerable amount of development work has been done.

#### Alpha Claim.

The Alpha claim lies near the top of the hill on the Eldorado Creek side about a mile from Moose Creek. The development work consists of a tunnel 120 feet long, the first 100 feet of which is timbered, and a shaft 20 feet deep situated 60 feet S. 25° W. from the end of the timbering. The vein matter is highly iron-stained quartz and contains sulphides and oxides of lead and copper. The bottom of the shaft exposed a mineralized zone 8 or 9 feet wide containing three bands of highly mineralized iron-stained quartz, each about one foot in width. Something over a ton of ore was sorted and sacked from the material excavated in sinking this shaft. A grab sample of this ore assayed by the Bureau of Mines showed 266.30 oz. of silver per ton.

### GLACIER CREEK

#### McGonagall Claims.

The McGonagall claims are located near the head of Glacier Creek.

The upper claim lies at an elevation of about 3,500 feet. The vein is exposed at the surface and is developed by a tunnel 30 feet long at the face of which 8 feet of mineralized quartz was exposed which carried some galena and a small amount of stibnite. Samples taken by the owners across the entire width of the face are reported to have yielded .60 oz. of gold and 63.00 oz. of silver per ton.

The lower claim is also situated on the right limit of the creek but approximately one-half mile to the west and several hundred feet lower in elevation. The vein is exposed at the surface and consists of 18 inches of quartz which is free milling. One ton of ore from this outcrop was sent to a testing plant in Seattle and milled, yielding \$30 in gold. A crosscut tunnel was started from the bank of the creek and driven to intersect this vein. At a distance of 30 feet from the portal it encountered a 3-ft. shear zone impregnated with gray copper, stibnite and chalcopryrite, from which assays containing as high as 52 oz. of silver per ton were secured. The tunnel was extended 15 feet beyond this shear zone without encountering the free milling quartz vein which it was being driven to intersect. A crosscut was then driven 12 feet to the right of the tunnel along the shear zone at the end of which the quartz vein was encountered.

It was discovered that the vein had been faulted and displaced to the left and that the tunnel had been driven through the fault. The tunnel is 4 feet by 6 feet in the clear and is timbered for the first 25 feet.

#### GLEN CREEK

Two prospects were discovered during the summer of 1921 near the head of the west fork of Glen Creek.

#### Arkansas Claim.

The first of these is known as the Arkansas claim, and the open cut at discovery exposed a mineralized zone about 14 feet wide, consisting of three bands of quartz separated by two bands of schist from right to left as follows: Five feet of quartz,  $2\frac{1}{2}$  feet of schist,  $1\frac{1}{2}$  feet of quartz,  $2\frac{1}{2}$  feet of schist,  $1\frac{1}{2}$  feet of quartz. A grab sample taken by the writer across the 5-ft. quartz band showed 90 oz. of silver per ton. The ore is chiefly sulphides of lead and antimony with some sphalerite.

#### Pension Claim.

The Pension claim lies about 1,500 feet farther up the creek. The open cut at discovery exposed a vein 5 feet wide, of which  $2\frac{1}{2}$  feet was nearly solid galena, the remainder being quartz. A grab sample, taken by the writer, of the  $2\frac{1}{2}$  feet of galena assayed 150 oz. of silver per ton. The owner was starting a tunnel about 25 feet below the outcrop at the time the claim was visited.

#### SPRUCE CREEK

Five claims have been located at the head of Spruce Creek, as follows:

#### Lucky Jim Claim.

The discovery cut on the Lucky Jim claim exposed a ledge of rusty quartz one foot in width which pans free gold and carries some galena and chalcopryrite.

#### Lena Claim.

The vein on the Lena claim is two feet wide and also consists of rusty quartz. It carries galena, some copper oxides or carbonates and some native silver. In an open cut 75 feet below discovery the vein is 3 feet in width.

#### Silver Wire Claim.

The discovery cut on the Silver Wire claim showed a quartz vein two feet in width, carrying galena and some copper oxides.

#### Mystery Claim.

At the Mystery claim the quartz vein is  $2\frac{1}{2}$  feet wide as exposed in the discovery cut, carrying galena, stibnite and copper oxides. No free silver was observed on this claim.

#### Ridgetop Claim.

The Ridgetop claim is located on the divide between Spruce and Crevice Creeks. The vein is 12 feet in width, consisting chiefly of iron-stained quartz and carrying a very little galena and some copper oxides.

### TRANSPORTATION

The only route available in the past for the transportation of any quantity of supplies to the Kantishna district is the water route down the Tanana River and up the Kantishna River to Roosevelt, and thence overland to the mines. The distance from Fairbanks to the mouth of the Kantishna is 155 miles, from the mouth of the Kantishna to Roosevelt is 156 miles, and from Roosevelt to Kantishna Post Office is 35 miles, a total of 346 miles to cover an "air line" distance of 135 miles. The rivers are, of course, navigable only during the summer months, but during that season of the year the first six miles of the overland portion of the route from Roosevelt to Kantishna are almost impassable for teams because of swamps. The usual procedure therefore involves the storage of the supplies at Roosevelt until the swamps are frozen, when they can be crossed by horses and sleds. The cost of transportation over this route is \$80 per ton—\$40 by water to Roosevelt and \$40 by sleds from Roosevelt to Kantishna. During the years 1919 and 1920 a special rate of \$32.50 per ton was made by the Alaska-Yukon Navigation Company for ore shipments from Roosevelt down the Kantishna River to St. Michael and thence by sea to Tacoma. This company has abandoned transportation on the Tanana River, owing to the completion of the Alaska Railroad, and this rate will probably not be duplicated.

Another route starts at McKinley Park station on the Alaska Railroad, which is 348 miles from Seward, and follows up Morris Creek, thence along the northern slope of the second foothill range (described on page 2) across Savage, Sanctuary and Teklanika Rivers, thence up Igloo Creek and around the southern end of Sable Mountain, thence through Polychrome and Highway Passes, past the northern end of Muldrow Glacier, down McKinley Fork and along the shores of Wonder Lake to Moose Creek in the Kantishna district. This route is used chiefly during the summer months when it is easily passable for pack-horses but not for wagons, and saves several days' travel compared with the river route. It is, of course, impossible to transport any quantity of supplies economically by these means. During the winter months deep snow and the absence of standing timber to prevent its drifting divert travel to other more favorable routes.

The favorite winter route has always been up Moose and Myrtle Creeks and over a low divide into Clearwater Creek, thence down that stream and Toklat River to the mouth of the Sushana and across the Tanana lowland to the railroad. The cost of transportation by dog teams, which are used exclusively on this route, is \$240 to \$300 per ton. In the future, however, this trail will undoubtedly be abandoned

in favor of a new one which the Alaska Road Commission is now building from Kobe, a station on the Alaska Railroad 387 miles from Seward, to the Kuskokwim mining region.

The Kuskokwim trail, which follows the southern edge of the Tanana lowland across Teklanika and Toklat Rivers, has been completed as far as Diamond on the Bearpaw River. From here it will run by way of Lake Minchumina to McGrath and Iditarod. It is being cut wide enough and the bridges are strong enough to accommodate heavy traffic. From Diamond a branch trail follows Bearpaw River, Glacier and Moose Creeks to Kantishna. The distance from Kobe to Diamond is 55 miles; from Diamond to Kantishna the distance is 25 miles. The cost of transportation over this route has not been definitely established. With horse-drawn sleds, which will probably be used to haul ore from the Kantishna district during the present winter, although caterpillar tractors are being considered, it is estimated at \$80 per ton from Kantishna to the railroad. Although this is no cheaper than the cost of water transportation, this route has a great advantage in the fact that the delay at Roosevelt is eliminated. Supplies will no longer have to be stored there until the swamps are frozen, and ore mined during the winter can be delivered at the smelter by way of the railroad several months earlier than when it is necessary to wait for river navigation to open in the summer. The one disadvantage of this route is due to the fact that the swampy ground over which it passes is absolutely impassable in the summer, nor could a summer wagon road that would suffice even for light equipment be constructed except at a prohibitive expense.

#### Fuel.

The majority of the mines in the Kantishna district are situated at a considerable distance from timber and the cost of fuel for domestic as well as mining purposes is extremely high. Coal deposits near the head of Moose Creek should be investigated and a mine sufficient for local needs should, if possible, be opened there.

### COPPER MOUNTAIN DISTRICT

The Copper Mountain district is situated near the northern terminus of Muldrow Glacier, which is the main source of water supply for the McKinley Fork of the Kantishna River. The district lies near Lat. 64° 20' N. and Long. 150° 20' W., about five miles south of the southern boundary of the map (a) accompanying U. S. Geological Survey bulletin 687.

(a)—The Kantishna Region, Alaska, Stephen R. Capps, Bull. U. S. Geol. Surv. 687, Washington 1919. Plate 1 in pocket.

#### LODE MINING

The Copper Mountain district was discovered early in the spring of 1921. It was visited by the writer in September, 1921, and September, 1922, on the return from trips to the Kantishna district, but owing to inclement weather in both cases time was available for only a brief reconnaissance of a portion of the district, and such examination as could be made was rendered extremely difficult by snow which masked much of the ground. The examinations were confined chiefly to the neighborhood of Grant Creek, a small stream rising in the heart of Copper Mountain and flowing north into McKinley Fork. The upper part of this stream flows through a steep, rock-walled canon and debouches across a terrace one-half to three-quarters of a mile wide before emptying into the gravel basin above the canon at the end of Muldrow Glacier.

#### Owen Claim.

The Owen claim is located across Grant Creek near the middle of this terrace. No well defined vein was observed, the deposit occurring in a zone of quartzite about 100 feet wide lying between two areas of granite. Portions of the quartzite are impregnated with galena, copper sulphides and some native copper.

#### Virginia Claim.

The Virginia claim is situated at the mouth of the rocky canon of Grant Creek about one-quarter of a mile above the Owen claim. At the discovery stake on this claim a ledge 30 feet wide was observed, having a strike of N. 75° E. and a dip of 75° S. The hanging wall is limestone and the foot wall porphyry. The vein matter is chiefly quartz containing banded streaks highly impregnated with galena. The proportion of galena bearing ore to the more barren quartz is perhaps that of 1 to 5. A sample of the galena bearing material from this vein taken at random by the writer assayed a trace of gold, 1.10 oz. of silver per ton and 4.18 percent lead.

About 75 feet to the south is a second vein 12 feet thick having a limestone foot wall and a granite hanging wall. The strike is S. 85° W. with a dip of 40° S. and the vein carries galena and sphalerite inter-banded with quartz. At a distance of 25 or 30 feet south of this is a third vein 8 feet in thickness having a strike due east and west and a dip of 70° S. The foot wall is granite and the hanging wall limestone. This vein also carries sulphides of lead and zinc. All three of these veins are exposed in the rocky walls of the canon and required practically no excavation to discover them.

#### Denver Claim.

On the Denver claim, 150 feet south of the third vein on the Virginia, is a 12-ft. ledge having a strike of N. 60° E. and a dip of 70° S. The vein matter is quartz containing some galena. At a point 100 feet east of the creek and 100 feet higher up on the hill the ledge carries

a considerable amount of copper stain, and the assay of a picked sample taken by the owners from this place showed 270 oz. of silver per ton.

A second ledge 50 feet to the south is 6 feet in width and has a strike of N. 70° E. and a dip of 70° S. The foot wall is granite but the hanging wall was concealed. A third vein on the Denver claim 75 feet further south is 7 feet in width and consists chiefly of quartz carrying lead sulphide. The strike and dip of this vein could not be determined. A sample broken at random from the ledge by the writer assayed .40 oz. of silver per ton and 5.87 percent lead.

#### Caribou Claim.

The main vein of the Caribou claim lies 200 feet south of the third vein on the Denver. Its strike is N. 75° W. and it has a dip of 50° N. The foot wall is granite. The lode, which appears to be a zone of quartzite of more than 100 feet in thickness, contains a band of galena bearing material along the foot wall 12 to 18 inches thick. At a distance of 12 feet from the foot wall is a zone of copper stained rock about 1 foot in thickness, with bands containing galena, sphalerite and pyrite 2 feet wide on either side. At a distance of 25 feet from the foot wall a similar band of copper stained rock with galena, sphalerite and pyrite on either side was also observed. Except for the band along the foot wall the ore in this lode appears to be "pockety."

Two other veins about 800 feet south of the Caribou are reported by the owners, one of which is 12 feet and the other 14 feet in width. The character of the ore is said to be similar to that on the Virginia.

#### Arizona Claim.

The Arizona claim is situated one-half mile west of the Virginia in a small gully which flows into Grant Creek. The deposit occurs in a band of quartzite 125 feet thick occurring between the masses of granite. Portions of this quartzite show considerable mineralization, galena and sphalerite being the chief constituents, with some pyrite and copper stain. A random sample of the mineralized quartzite taken by the writer showed .50 oz. of silver per ton and 3.98 percent lead. The strike of a porphyry dike 12 feet wide occurring in the granite 15 feet from the lower contact with the quartzite is N. 70° E. The dip is 40° S.

#### Montana Claim.

The Montana claim lies just above the Arizona and contains two ledges about 50 feet apart, each of which is two feet in thickness. The vein matter of both ledges is quartz and both carry galena and sphalerite. In the upper ledge, however, galena is predominant, while the lower ledge is chiefly sphalerite. A selected sample from the lower ledge taken by the writer assayed .40 oz. of silver per ton and 57.36 percent zinc.

#### Giles Claim.

The Giles claim lies east of the Virginia and Denver claims, along

the face of the bluff east of Grant Creek and south of the terrace of McKinley Fork.

At discovery an open cut 30 feet long and from 5 to 15 feet wide was excavated during the summer of 1922. An extensive body of ore, which appears to be an impregnation in the limestone, has been exposed across the entire face of this cut. Several tons of the ore were piled at the edge of the cut and more than 100 tons were mixed with the waste scattered down the slope of the hill below the cut. The ore consists chiefly of galena and sphalerite in a limestone gangue, but a small amount of chalcopryrite, which occurs as a filling in incipient cracks of the ore, was also observed. A sample of the ore was taken and assayed at the Alaska Station of the Bureau of Mines with the following results: Gold, trace; silver, 2.20 oz. per ton; lead, 6.35 percent; zinc, 9.05 percent, and copper, 0.38 percent.

The ore shows also on the point of the ridge 300 feet west of discovery in an open cut which was partly caved. This cut is on the east bank of a small gully and the ore is also exposed in an open cut on the west bank of the gully. This cut was filled by a deep snow drift. The course between the two cuts is N. 80° E. A big deposit of light colored porphyritic rock, belonging to the granite or the diorite group, occurs about 20 feet north of the west cut.

#### Other Claims.

Approximately fifty other claims have been located, for the examination of which time was not available. Those described above, however, are fairly typical of the district and serve to indicate the abundance of lead and zinc ores found there.

#### Fuel.

There is no standing timber within 20 miles of the property and hence the question of fuel, both for domestic needs and for possible future mining operations, is important. Fortunately an outcrop of sub-bituminous coal has been discovered on the west fork of Stony Creek, one of the tributaries of the Toklat River, at Lat. 65° 30' N. and Long. 154° 15' W., at a distance of 8 or 9 miles from the property. The exact thickness of this bed is unknown, but more than 30 feet are exposed at a point where several tons were mined and transported to the property by pack horses. The resulting pile of coal was sampled by the writer and analyzed by the Pittsburgh station of the Bureau of Mines with the following results:

	Moisture	Ash	Volatile matter	Fixed carbon	b.t.u.
As received .....	21.2	9.0	36.6	33.2	8530
Moisture free .....		11.4	46.4	42.2	10830
Moisture and ash free..			52.4	47.6	12220

## TRANSPORTATION

From the viewpoint of transportation the Copper Mountain district is in even more dire straits than the Kantishna district. The only method available at present for getting supplies to the district in any quantity is by dog team from Kantishna during the winter months. The distance from Kantishna Post Office to the Copper Mountain district by way of Wonder Lake and McKinley Fork is about 25 miles. It would be possible, although difficult, to haul supplies from there by horse sleds in winter. The Polychrome-Highway Pass trail described on page 133 passes through the edge of the Copper Mountain district but as has been already stated this is passable during the summer months only for pack trains or men on foot, while during the winter months deep snows make travel very difficult. It would be possible, however, to make a fairly good wagon road for the 65 miles along this route which would also give access to the scenic beauties of Mt. McKinley National Park through which it passes.

## LITTLE MOOSE CREEK

Little Moose Creek is one of the tributaries of Clearwater Fork, joining that stream about 5 miles above its confluence with Toklat River.

The principal activity in this district is placer mining, the methods employed being similar to those in the Kantishna district. The placers are distinguished by the occurrence of native silver, small nuggets of which are found in practically every clean-up.

During 1922 the principal operators were Federson and Christianson, Fred Hauselman, and Mike Lody. Approximately 30,000 square feet of bedrock, valued at twenty-two cents per square foot, were cleaned during the season.

## REVIEW OF COAL MINES BY FIELDS

### MATANUSKA COAL FIELD

During 1922 there were five operating coal properties in the Matanuska field, four of which were privately owned.

Private operators in this field produced 45,402 tons of coal during the year. The Alaskan Engineering Commission, operating on reserved units, mined 8,256 tons.

The most significant features of the 1922 development in the Matanuska field were the awards made to private operators of contracts to furnish the coal used on the Alaska Railway during the current fiscal year and the consequent active development of new coal properties in the Moose Creek section of the field. The yield from the Moose Creek beds would have been materially greater but for the severe handicap

occasioned by lack of adequate transportation facilities between the mines and the railway.

The distances from the properties on Moose Creek, capable of producing coal to the railway, are from 4 to 8 miles. Hauling can be done only in winter and even then is restricted to periods during which conditions favorable to sledding exist. Such periods were of very short duration during the past winter.

### Evan Jones Coal Company.

The mine of the Evan Jones Coal Company at Jonesville made the largest output of coal produced in the Territory in 1922. The total tonnage mined at this property during the year amounted to 42,412 tons. The greatest monthly output was made in September, 1922, when 5,499 tons were shipped.

A disastrous fire occurred in this mine on November 19, 1922. In order to quench the fire, flooding of the mine with water became necessary and production was stopped during the remainder of the year. Prior to the occurrence of the fire, extensive underground development work was completed during the year. The main crosscut entry tunnel was extended until it now has a total length of 850 feet.

A haulage slope was sunk from the main-level gangway on Bed No. 3 to the second level, which is 265 feet lower on the slope than the main level. Gangways were driven on the second level on beds 2, 3 and 4, and most of the coal mined during the year was secured from rooms driven off these gangways.

The power equipment on the property was augmented during the year by the erection at the mine of the machinery formerly placed on the Netland property at Chickaloon.

A new crosscut entry tunnel, designed to intercept the coal beds at the elevation of the lower or second level was commenced in the fall of 1922. Work on this tunnel was later stopped owing to difficulties arising from caving ground encountered.

At the close of the year work was proceeding on the driving of a second escapeway from the lower level to the surface.

The Evan Jones mine is provided with a railway spur which offers excellent shipping facilities.

### Eska Mine.

The Eska mine of the Alaskan Engineering Commission was idle during most of the year 1922. The Commission relied upon the output of the Evan Jones mine for its supply of coal for the railway during the year. The fire at the Evan Jones mine made it imperative to re-open the Eska mine immediately, in order to forestall the threatened shortage of coal for railway use.

Owing to the excellent conditions existing at the Eska property, production was resumed within four days following the Jonesville fire. At the end of the year a crew of 83 men was employed at the mine and 2,662 tons of coal had been shipped.



**Baxter Mine.**

The Baxter mine, situated on Moose Creek, was idle from April until December, 1922, owing to the impossibility of hauling coal to the railway except by means of sleds.

During the year this property produced 2,729 tons of coal of excellent quality. The maximum monthly output was 1,104 tons, which was mined in February.

An attempt was made during the winter of 1922-1923 to utilize motor tractors in hauling the Baxter coal to the railway. This attempt was unsuccessful owing to the prevalence of "soft" weather.

**Bruno Agostino Moose Creek Coal Co.**

The mine of the Bruno Agostino Moose Creek Coal Company, situated about a mile below the Baxter mine on Moose Creek, was developed and put upon a producing basis during the year 1922.

The original and principal development was done on a 9-ft. coal seam outcropping on the east side of Moose Creek. Approximately 500 feet of underground work was completed. This work included the sinking of a haulage slope to a depth of 180 feet on the bed, and the driving of a parallel air course and two connecting crosscuts.

During the fall prospecting work revealed outcrops of a series of beds on the opposite or west side of Moose Creek and about 600 feet distant from the above described workings. These outcrops were of such promise that work was intensively centered upon their development and was discontinued in the other bed where ice and water conditions rendered progress difficult.

Exploration of the newly discovered beds by means of a crosscut tunnel revealed three seams,  $3\frac{1}{2}$  feet, 5 feet and  $6\frac{1}{2}$  feet, respectively, in width.

The coal produced at the Agostino property is of excellent quality. Samples of five thousand tons mined indicate an average heating value of 12,162 B. T. U.'s and an ash content of 12.95 percent.

A substantial permanent camp of log buildings was erected on the Agostino property and much work was done by the Company on the road leading from their mine to the railway.

**Rawson Mine.**

The Rawson mine is situated on Moose Creek about  $2\frac{1}{2}$  miles above the Baxter mine. Development work has been done on the property during the past two years but no production has been made. A crosscut tunnel has revealed a series of five parallel beds of coal, ranging from 1½ feet to 9 feet in thickness. One of these seams that has a thickness of 8 feet has been drifted upon for about 80 feet. This seam carries about 6 feet of clean coal of good grade. Another seam, 9 feet in thickness, has 8 feet of clean coal of similar or better grade.

Development work was also done on a sixth seam, parallel to the series above described. A gangway has opened this seam for a length

of 55 feet. The bed has a thickness of  $7\frac{1}{2}$  feet. Work on the gangway was still in progress at the close of the year. Many surface improvements were made on the Rawson property during the year. These included log camp buildings, storage bins, etc. A road was also constructed by Mr. Rawson from his camp down Moose Creek to the Baxter mine. The work on this road, which is  $2\frac{1}{2}$  miles in length, included the building of a bridge across Moose Creek.

**Leroy Prospect.**

An extensive area extending approximately four miles along Moose Creek is held by Wm. T. Leroy, who spent much of the season of 1922 exploring the surface of his holdings. This work was successful and resulted in exposing a series of coal seams and establishing their continuity with a fair degree of certainty over a strike distance of approximately  $1\frac{1}{2}$  miles.

This series is thought to be the easterly extension of the beds opened on the adjoining Rawson property above described.

The outcrops lie in such positions on the north flank of Wishbone Hill as to offer very favorable conditions for the conduct of mining operations.

The widths and mineability of the beds have not been determined.

Tunneling operations planned for the coming season will assist in establishing these features.

**Reserved Units in the Chickaloon Section.**

Mining operations conducted by the Navy Alaska Coal Commission on reserved units embracing the Chickaloon and Coal Creek mines and the King's River prospect were indefinitely suspended May 1, 1922, with the exception of a small amount of diamond drilling in the vicinity of the Chickaloon mine that was continued until the latter part of May.

The Chickaloon mine was temporarily reopened during July and August for the purpose of securing additional coal to form a part of a lot of 5,000 tons used in making a Naval test. The total tonnage mined at Chickaloon during the year amounted to 4,645 tons.

The output of the Coal Creek mine for the 4 months' period during which operations were conducted was 949 tons.

The beds at the Chickaloon and Coal Creek mines yield coking semi-bituminous coal of Naval grade.

**Lindquist Prospect.**

Prospecting work was commenced in November, 1922, on a coal seam found in the King's River section on a property held under permit by A. P. Lindquist of Anchorage. Prior to the end of the year a camp had been established, a road had been constructed connecting the camp with the King's River road, and a gangway 31 feet in length had been driven upon the coal bed. The work on this gangway resulted in the production of 74 tons of coal. Analysis of a mine sample of this coal showed it to be coking and of semi-bituminous grade, with a heat value,

as received, of 12,541 B. T. U.'s, an ash content of 15.43 percent. The moisture content, as received, was 0.51 percent, the volatile matter 26.14 percent, and the fixed carbon 57.92.

#### Netland Prospect.

No work has been done on the Netland property during 1922. This prospect adjoins the Chickaloon reserved unit on the west.

### NENANA COAL FIELD

Mining development in the Nenana coal field in 1922 is described in detail in an article by Mr. Jno. A. Davis of the U. S. Bureau of Mines, which appears elsewhere in this report.

#### BROAD PASS REGION

##### Mt. McKinley Bituminous Coal Corporation.

Development work was commenced in the fall of 1922 on a coal seam discovered in the Broad Pass section adjacent to the Alaska Railway, near Mile 341.

The first exposure of this bed was made in an open cut on the top of a ridge bordering the railway.

The elevation of the cut is about 3,000 feet above sea level and 1,500 feet above the railway.

The seam where exposed in the cut has a width of about 6 feet.

The bed has a strike of N. 65° E. and a dip of about 60° N. W.

The direction of the above strike is approximately at right angles to the line of the railway, which the seam may cross on its easterly extension.

Work has been continued throughout the winter in the development of this property.

Five tunnels have been driven on the coal seam within a vertical range of 500 feet below the above described cut. These tunnels show the seam to have a width of from 6 feet to 10 feet or more, so far as explored.

Analyses of samples of the coal from the above described workings show it to be non-coking and of a grade closely approaching bituminous.

### COOK INLET COAL FIELD

Operations were conducted intermittently during 1922 at the McNally and Maitland lignite mine at Homer on Kachemak Bay, Cook Inlet. No mining was done after September 1st.

The total output for the year amounted to 2,729 tons.

### BERING RIVER COAL FIELD

#### Bering River Coal Company.

The only coal produced in the Bering River field in 1922 was a lot of 950 tons, mined on the property of the Bering Coal Company, to be used in making a Naval test. The coal mined was washed at the property and thus reduced to a 600-ton sample. This work was done during June and July, 1922, and following its completion operations at the mine were indefinitely suspended.

## COAL MINING IN THE NENANA FIELD, ALASKA

By JOHN A. DAVIS,

Superintendent, Alaska Experiment Station, U. S. Bureau of Mines.

### INTRODUCTION

#### LOCATION

The Nenana coal field is situated in the northern foothills of the Alaska Range near Latitude 64° N. and between Longitude 147° W. and 150° W. The Alaska Railroad, which was constructed and is operated by the United States Government between Seward and Fairbanks, crosses the field near the center. The distance from Seward to Healy at the southern end of the field is 358 miles. The distance from this point to Fairbanks is 112 miles. West of the railroad the coal field is 5 to 10 miles wide and extends as far as Toklat River, a distance of 40 miles; east of the railroad it extends beyond Wood River, a distance of 50 miles, and in places it is more than 20 miles in width.

#### DRAINAGE

Nenana River is the principal stream in the area. It has its headwaters on the southern slope of the Alaska Range, flowing north in a deep canyon through the range and thence in an open valley across the coal field to join the Tanana River, which is one of the main tributaries of the Yukon. The chief tributaries of Nenana River within the area embraced by the coal field are Healy River and Lignite Creek, which join it from the east, and Dry Creek, which joins it from the west. Teklanika River parallels the Nenana at a distance of 15 miles to the west; its main tributaries are Sanctuary and Savage Rivers. West of this the field is crossed by Shushana River and East Fork, both of which are tributaries of Toklat River, which flows north into Kantishna River. East of Nenana

River the field is crossed by Totatlanika and Wood Rivers, which flow northward into the Tanana.

### TOPOGRAPHY

The coal bearing rocks are found in broad open valleys having an east and west trend and crossing the main streams at right angles. The hills which border these valleys are high and rugged and, were it not for the dominance of the higher Alaska Range to the south, they would be termed mountains.

Near the mouth of Healy River the Nenana debouches from a deep canyon in the schist which forms the backbone of the foothill range, and flows north in an open valley eroded across the coal bearing formation. On both sides of the valley the coal bearing rocks rise in bluffs or terraces varying in height from 100 to 500 feet. Opposite the mouth of Healy River the terrace is about 100 feet high and from 600 to 1,000 feet wide, the ground then rising to a second terrace. Along the east bank of the Nenana and also along the west bank a few miles below the mouth of Healy River the terraces are much higher.

### GEOLOGY

The coal bearing formation, which is of Tertiary age (probably Eocene) rests unconformably upon Pre-Ordovician Birch Creek schist. It is more than 2,300 feet in thickness and consists of soft light colored sandstones, light colored shales and beds of coal, the sandstones predominating. Approximately one-tenth of the total thickness of the formation is made up of coal beds, six of which are 20 feet or more in thickness. The following geologic sections were measured by the writer on the north bank of Healy River.

Stratigraphic Section of the Nenana Coal Bearing Formation Measured by John A. Davis on the Property of the Healy River Coal Corporation, Situated in Sections 23 and 24, T. 12 S., R. 7 W., F. B. M. at Suntrana:

	Feet	Inches
"Nenana" gravel .....	75+	
Unconformity .....		
Shale, with thin beds of sandstone .....	50	
Coal .....	4	
Sandstone .....	100	
Coal .....	2	6
Shale .....	7	
Bone .....	1	
Shale .....	1	
Coal, fair quality .....	3	
Shale .....	10	
Bony shale .....	1	
Concealed .....	140	
Bony coal and bone .....	4	
Light buff sandstone .....	65	
Bony coal .....	1	
Shale .....	7	
Bone .....	0	6
Shale .....	5	6
Bony coal .....	1	6
Sandy shale .....	70	
Light buff sandstone .....	30	
Coal .....	1	6
Brown shale .....	2	

	Feet	Inches
Sandy shale .....	14	
Carbonaceous shale and bone .....	2	
Light buff sandstone .....	23	
Brown shale .....	4	
Coal .....	1	6
Gray sandy shale .....	15	
Coal .....	1	4
Carbonaceous shale .....	1	8
Gray shale .....	15	
Buff sandstone .....	61	
Conglomerate .....	0	8
Coal, good quality, "Sharkey Bed" .....	19	
Sandy shale .....	1	
Coal .....	2	
Fine white sandstone .....	51	
Coal .....	5	
Shale and bone } "Wilson Bed" .....	6	
Coal .....	2	
Sandy shale .....	6	
Coal .....	7	6
Light yellow sandstone .....	180	
Coal .....	1	6
Shale .....	8	
Coal .....	3	
Shale .....	10	
Coal .....	1	
Shale .....	10	
Soft white sandstone .....	36	
Coal .....	1	
Sandy shale .....	10	
Soft white sandstone .....	10	
Coal .....	6	
Shale .....	2	
Coal, very good quality } "Jinx Bed" .....	18	
Gray sandy shale .....	20	
White and buff sandstone .....	70	
Coal, good quality "Donaldson Bed" .....	23	
Gray sandy shale .....	40	
Soft white sandstone .....	50	
Coal, good quality "Lathrop Bed" .....	26	
Gray sandy shale .....	6	
Soft light colored sandstone .....	23	
Coal, good quality, "Bowen Bed" .....	46	6
White sandstone .....	30	
Bony coal .....	4	
Shale .....	6	
Bone .....	3	
Shale .....	7	
Sandstone .....	70	
Sandy shale, suitable for brick clay .....	110	
Coal .....	4	
Gray shale .....	1	
Coal .....	1	7
Gray shale .....	0	9
Coal .....	2	2
Dark shale .....	2	
Coal, good quality .....	10	
Gray shale, partly concealed .....	13	6
Fine white sandstone .....	25	
Coal .....	3	4
Gray shale .....	0	7
Coal .....	0	6
Black carbonaceous shale .....	1	10
Gray shale .....	0	10
Coal .....	7	
Gray shale .....	8	
Buff shale .....	1	4
Coal .....	10	
Sandy shale .....	3	10
Coal, good quality .....	1	2
Carbonaceous shale .....	4	5
Coal, good quality .....	40	
Concealed .....	26	
Coal, good quality .....	1	6
Bony coal .....	6	
Light gray sandy shale .....	55	
Coarse white sandstone .....	1	6
Carbonaceous clay .....		

	Feet	Inches
Fine white sandstone and sandy clay .....	30	6
Bone and bony shale .....	3	6
Sandy clay .....	3	
Fine white and yellow sandstone .....	12	
Carbonaceous clay .....	0	6
Gray clay .....	3	
Coal, fair quality .....	3	
Sandy shale .....	3	
Fine white sandstone .....	8	
Coarse white sandstone and fine conglomerate .....	16	
Coal, good quality .....	3	10
Gray shale .....	1	6
Bone .....	0	10
Coal, good quality .....	5	10
Clay parting .....	0	1
Coal, good quality .....	5	
Bony coal .....	1	
Coal, fair quality .....	6	
Bony coal .....	1	
Fine white sandstone, partly concealed .....	1	
Coal, partly concealed, estimated thickness .....	50	
White sandstone, partly concealed .....	15	
Coal blossom, estimated thickness of bed .....	30	
Concealed .....	16	
Ashes and coal blossom, estimated thickness of bed .....	40	
Coarse white sandstone and fine conglomerate .....	10	
Unconformity .....	200	
Birch Creek Schist .....	100+	

Stratigraphic Section of Nenana Coal Bearing Formation Measured by John A. Davis on the North Bank of Healy River, in Section 22, T 12 S., R. 7 W., E. B. M., 1½ miles west of Suntrana:

	Feet	Inches
"Nenana" gravel .....	100+	
Unconformity .....	75	
Light buff sandstone .....	2	
Coal .....	18	
Gray shale .....	4	
Shale .....	2	
Bony coal .....	3	6
Shale .....	3	
Coal .....	4	
Blue clay .....	12	
Light yellow sandstone .....	94	
Conglomerate .....	2	
Bony coal .....	1	3
Gray shale .....	4	
Bony coal .....	3	
Gray shale .....	10	
Light buff sandstone .....	98	
Bony coal .....	3	8
Gray sandy shale .....	1	6
Light buff sandstone .....	90	
Conglomerate .....	1	6
Gray shale .....	7	6
Buff sandstone .....	7	
Sandy shale .....	3	
Bony coal .....	0	6
Sandy shale .....	7	
Light buff sandstone .....	46	
Iron stained conglomerate .....	0	6
Coal, good quality, "Sharkey Bed" .....	11	6
White sandstone .....	38	
Coal .....	2	6
Shale .....	1	6
Bony coal .....	1	6
Shale .....	1	6
Bony coal .....	0	6
Shale .....	1	
White sandstone .....	13	
Coal .....	2	9
Shale .....	0	8
Light colored sandstone .....	53	

	Feet	Inches
Bony coal .....	1	
Shale .....	2	
White sandstone .....	15	
Coal .....	0	6
Coarse white sandstone, bottom concealed .....	90+	

At the base of the coal bearing formation the beds dip to the north at angles varying from 30 to 45 degrees; but within a distance of a mile or so they rise on the opposite flank of a syncline and the formation extends to the north in a succession of anticlines and synclines for a distance of 10 miles on the west bank and 25 miles on the east bank of the Nenana River.

The geology of this area has been described at length by Martin (a) and by Capps (b) in publications of the U. S. Geological Survey to which the reader is referred for further details.

## EARLY COAL MINING OPERATIONS

### LYNN MINE

The first mine opened in the Nenana Field was known locally as the Lynn mine. It was situated on the east side of the Nenana River near the right-of-way of the Alaska Railroad, at a point 385 miles from the Seward terminus of the road. The coal bed at this mine is a little over five feet in thickness and occurs near the top of the geologic section of the coal bearing formation, although its exact stratigraphic position has never been definitely determined. It was the first outcrop to become available as the railroad was being constructed south from the town of Nenana, which is situated on the Tanana River 411 miles from Seward. It was clearly recognized that this fuel was inferior in quality to that obtainable further south, hence the mine was opened only for temporary use until the railroad could be built to the better coal.

The product of the mine was a poor grade of lignite, having a decided brown color and a woody texture. It contained some waste material due to the crude methods of mining necessarily adopted. It was used by the Alaskan Engineering Commission, the agency having in charge the building of the railroad, on locomotives and in the power plant at Nenana for about a year before the mine was abandoned in 1919.

Six samples were taken by the Commission at 20-ft. intervals in the 100-ft. tunnel at this mine and were analyzed at the Pittsburgh station of the Bureau of Mines. The average of these analyses shows: Moisture, 32.8 percent; volatile matter, 33.8 percent; fixed carbon, 21.5 percent; ash, 11.9 percent, and B. T. U. per lb., 6,220.

- (a)—The Nenana Coal Field, Alaska, G. C. Martin, Bull. U. S. Geol. Survey 664, Washington, 1919.  
 (b)—The Bonfield Region, Alaska, Stephen R. Capps, Bull. U. S. Geol. Survey 501, Washington, 1912.  
 The Kantishna Region, Alaska, Stephen R. Capps, Bull. U. S. Geol. Survey 687, Washington, 1919.

A steaming test made by the writer in 1919 at the Nenana power plant showed an equivalent evaporation of 3.98 pounds of water per pound of fuel as fired, in comparison with an evaporation of 3.68 pounds of water per pound of fuel as fired obtained during a similar test when using spruce wood.

#### BURNS MINE

Early in 1919, as soon as railroad construction had been extended 20 miles further to the south, the Burns mine was opened on the west bank of the Nenana River a few hundred yards from the right-of-way. The principal bed here was 8 to 10 feet thick. It contained a better grade of lignite which was brownish black in color and had a less pronounced woody texture than in the Lynn mine. Owing to complicated geologic structure the stratigraphic position of this bed has never been definitely determined. The mine furnished fuel for the Alaskan Engineering Commission's needs and to a small extent for domestic purposes in the town of Nenana and was operated for little more than a year, when it was abandoned in favor of a still better grade of fuel obtainable further to the south.

A typical analysis of this fuel shows: Moisture, 29.6 percent; volatile matter, 34.2 percent; fixed carbon, 28.6 percent; ash, 7.6 percent, and B. T. U. per pound, 7,448. A steaming test made by the writer during the same week as that for the Lynn mine resulted in an equivalent evaporation of 3.99 pounds of water per pound of fuel as fired.

#### CALDERHEAD MINE

The Broad Pass Coal and Development Company obtained a permit early in 1920 to open a mine on the government reserve in Section 5, Township 12 S., Range 7 W., Fairbanks Base and Meridian. This mine, which was known locally as the Calderhead mine, was situated on the south bank of Lignite Creek one and a half miles from its confluence with Nenana River. The coal bed is 18 feet thick, of which the upper 6 feet, being of somewhat inferior quality, was left to support the roof. The lower 12 feet consists of a good quality of lignite which is dull black in color and shows but few traces of woody texture. It was transported in sleds on the ice down Lignite Creek and across the Nenana River to the railroad. The first season's work was terminated in April, 1920, by the "break-up" of the Nenana River after 7,000 tons had been mined. Approximately 200 tons were taken out during the winter of 1920-21, and 3,000 tons during the winter of 1921-22, after which the mine was definitely abandoned.

A typical analysis of this fuel made by the Pittsburgh station of the Bureau of Mines shows: Moisture, 26.4 percent; volatile matter, 35.8 percent; fixed carbon, 28.3 percent; ash, 9.5 percent, and B. T. U. per pound, 7,573. The sample was taken from fuel used during a steaming test made by the writer in 1920 at the Nenana power plant, which re-

sulted in an equivalent evaporation of 4.33 pounds of water per pound of fuel as fired.

#### PETERSON MINE

The Peterson mine, which was the most extensive of the early attempts at coal mining, was owned by the Healy River Coal Corporation. It was situated on the west bank of the Nenana River opposite the mouth of Healy River, in Leasing Block 26, Nenana Coal Field. The mine was opened early in 1920 by a crosscut tunnel, starting at the edge of Nenana River just above high water mark and running in a southwesterly direction under the terrace on the west bank of the river. Workings extended from this crosscut developed two beds of coal, the upper one of which had a thickness of 5 feet and the lower one 6 feet.

The mineable portions of these two beds lying between the horizon of the entry tunnel and the surface have been practically all removed with the exception of pillars left to protect the tracks of the Alaska Railway, beneath which the beds extend. The gangways driven on the upper bed had an aggregate length of approximately 650 feet and those on the lower bed 360 feet.

The upper bed has a strike of N. 80° E. and dips north at angles varying from 39° to 52°. The lower bed strikes N. 75° E. and dips from 30° to 40° north.

At the portal of the main tunnel the coal was dumped from the mine cars into a 10-ton skip which was hoisted on an inclined tramway 336 feet long. The incline followed the natural slope of the bluff for 226 feet and was carried on a trestle for the remaining distance. At the top of the incline the coal was discharged over a 1-inch grizzly, the oversize going to a 350-ton bunker erected beside a spurtrack of the railroad, and discharging directly into railroad cars.

The following analyses of samples of coal from the Peterson mine have been made by the U. S. Bureau of Mines:

		Moisture	Ash	Volatile Matter	Fixed Carbon	B.t.u.
Sample of coal	As received	18.65	12.50	37.55	31.30	
from west en-	Moisture free		15.37	46.16	38.47	
try, Aug. 9,	Moisture and ash free			54.54	45.46	
1920.						
Sample of 35-	As received	19.49	13.74	36.72	30.05	
330 lbs. deliver-	Moisture free		17.06	45.61	37.33	
ed to U.S.B.M.	Moisture and ash free			54.99	45.01	
Jan. 10, 1921.						
Sample of 6	As received	19.23	14.29	34.88	31.60	8,434
carloads deliver-	Moisture free		17.69	43.18	39.13	10,442
ed to A.E.C.	Moisture and ash free			52.46	47.54	12,636
at Nenana Jan.						
25, 1921.						
Sample of 63-	As received	20.67	13.73	36.44	29.14	
380 lbs. deliver-	Moisture free		17.34	45.94	36.72	
ed to U.S.B.M.	Moisture and ash free			55.58	44.42	
Feb. 20, 1921.						
Sample of 3	As received	20.04	13.09	37.27	29.60	
cars chosen at	Moisture free		16.37	46.62	37.01	
random from	Moisture and ash free			55.74	44.26	
run of mine de-						
liveries Sept.						
22, 1921.						

Comparison with analyses published by the United States Bureau of Mines (a) of typical lignites, such as those found in North Dakota, and of typical sub-bituminous coals, such as those of Routt County, Colorado, for example, places the Nenana fuel midway between these two classifications as far as chemical composition is concerned. In appearance the coal is black and often shiny and although woody texture can be observed it is not so marked a feature as in the North Dakota lignite. The streak is a very dark brown—almost black—and the coal offers a great deal of resistance to weathering, particularly in certain portions of the bed. Since these physical characteristics are more typically those of sub-bituminous coal than of lignite, the product of this mine should properly be classed as sub-bituminous coal.

The Peterson mine produced approximately 12,500 tons of coal, of which 11,000 tons were furnished to the Alaskan Engineering Commission for use in locomotives, steam shovels and pumps, for the heating of buildings and for the power plant at Nenana. The town of Nenana consumed about 700 tons for domestic purposes and approximately 800 tons were shipped to Fairbanks, also for domestic use. The price of the coal at the mine bunker in small lots was \$5 per ton, but under contract in large lots a price of \$4.50 per ton was made. Delivered at Nenana for domestic purposes the coal sold for \$7 to \$7.50 per ton, and at Fairbanks the price was \$9.50 per ton delivered to the consumer in small lots but under contract involving 100 tons or more a price of \$9 per ton was made. No coal was mined after January 1, 1922, and on October 6, 1922, the lessees obtained a cancellation of the lease.

#### NEW MINE

During the summer of 1921 the Healy River Coal Corporation started a second mine in Leasing Block 26 on a coal bed about 1,000 feet north-west of the Peterson tunnel. It was known locally as the "new" mine and was opened by an inclined shaft extending to a depth of 157 feet on a 30° slope. From the bottom of the shaft a tunnel was driven along the strike of the vein, which is N. 75° E., for a distance of 140 feet to the face of the bluff along the river, and also in a westerly direction along the strike for a distance of 300 feet. The bed dips about 55° N.

Owing to the proximity of buildings and property of the Alaska Railroad only that portion of the coal in this mine east of the shaft was removed prior to August 25, 1922, when the application for the cancellation of the lease was made. The total production amounted to 1,500 tons.

The quality of the coal was practically identical with that in the Peterson mine, except for a slightly higher moisture content. The following analysis of a sample taken by the writer at the foot of the inclined shaft was made at the Alaska Station of the Bureau of Mines:

	Moisture	Ash	Volatile Matter	Fixed Carbon
Sample of bed at foot As received .....	24.17	12.93	34.88	28.02
of incline of "new" Moisture free .....		17.05	43.99	36.96
mine in Block 26, Oct. Moisture and ash free ...			55.45	44.55
4, 1921.				

(a)—Analyses of Coals in the United States, N. W. Lord and others, Bull. U. S. Bureau of Mines 22, Washington, 1913.

## PRESENT MINING OPERATIONS

### SUNTRANA MINE

The only coal mining operations in the Nenana field at present are those of the Healy River Coal Corporation at Suntrana on the north side of Healy River 2½ miles from its confluence with Nenana River. Connection with the Alaska Railroad is afforded by a 4-mile spur which leaves the main line one mile north of Healy. The development of the Suntrana mine was started in November, 1921, under a prospecting permit, but the results of the first season's work were so satisfactory that application was made for the cancellation of the old lease on Block 26 and the issuance of a new one at Suntrana which is now pending.

About a quarter of a mile southwest of Suntrana, Healy River turns abruptly north from a deep gorge eroded in Birch Creek Schist across the successive strata of the over-lying coal bearing formation until the Bowen bed (a) is reached, when it flows in a westerly direction to join Nenana River. The coal bearing rocks, which dip to the north at angles ranging from 30° to 45°, are unusually well exposed on the north bank of the river in the nearly vertical cliffs that rise to a height of 700 or 800 feet except where cut by the steep canon of Coal Creek in the western part and by the canon of Cascade Creek near the center of the property. At the top of the cliffs the surface of the ground rises gently to the crest of the divide between Healy River and Lignite Creek.

The first season's work at Suntrana, which partook somewhat of the nature of prospecting, was terminated in June, 1922, because of high water in Healy and Nenana Rivers. The mine had no railroad connection at that time, since the present spur was not completed until October 26, 1922. The coal was hauled by horses down Healy River during the winter months in 2-ton sleds and hoisted up the incline at the Peterson mine. After the break-up of Healy and Nenana Rivers, which stopped hauling on the ice, wagons and a 45-horsepower Holt caterpillar tractor were used and the coal was hoisted on a cable tramway extending from a landing station on the east bank of Nenana River to the top of the Peterson bunker. Approximately 12,000 tons were mined during the first season, the majority of which was used by the Alaskan Engineering Commission. Of this, 400 tons were shipped to Anchorage for trial in the power plant at that place. Several hundred tons were used at Nenana both in the power plant and for domestic purposes, and a smaller amount was shipped to Fairbanks, chiefly for domestic use. The first season's production was taken from three entries on the Bowen bed which were named Negri, Conley and Keyes tunnels and extended along the cliffs from east to west in the order given.

With the resumption of mining operations at Suntrana in the fall of 1922, work was started on a systematic plan for mining the coal in six of the beds on the property. This comprises a main crosscut tunnel start-

(a)—See the stratigraphic section of the Nenana coal bearing formation, page 144.



ing at a point on the Bowen bed 15 feet above the portal of the Conley tunnel and running nearly at right angles to the strike of the coal-bearing formation. It will be driven through the various coal beds until the Sharkey bed is reached, which it is estimated will be at a distance of 1,050 feet from the portal.

On January 1, 1923, the main tunnel had been driven along a course of N. 16½° E. for a distance of 150 feet. At a point 115 feet from the portal an entry had been turned off to the left and driven 230 feet along the strike of the Lathrop bed. Another entry, which was 35 feet long, had also been started to the right on the Lathrop bed; but in driving it a heavy seepage of water, which probably originated in Cascade Creek, was met with and upon encountering the cold air in the entry it promptly turned to ice, thus temporarily preventing further driving in that direction. Three raises had been driven up the slope of the Lathrop bed from the left entry and connected by crosscuts with two air openings on the outcrop. The breasts in these raises had advanced to within 30, 40 and 60 feet of the outcrop, respectively, taken from east to west in the order given.

At the portal of the main tunnel the mine cars, which are of the side dumping type and have a capacity of 2,250 pounds, are trammed by hand along a new trestle 35 feet high and 185 feet long at the end of which the coal is dumped over a grizzly 3 feet wide, 12 feet long and made of 5/8-inch flat steel bars spaced 4 inches apart. The oversize, or "lump" coal, passes down a steel lined chute set at an angle of 25° and is discharged directly into railroad cars on the main track of the Suntrana coal spur. The undersize falls to a second grizzly of the same dimensions but made of 1/2-inch flat steel bars spaced 2 inches apart. The oversize of this screen, or "nut" coal, passes down another steel lined chute set at an angle of 32° and falls into railroad cars on a short siding 18 feet north of the spur track. The undersize, or "screenings," falls into a hopper from which it is discharged into railroad cars on a second short siding 18 feet north of the first one. The proportions of the various sizes are: 30 percent lump; 50 percent nut, and 20 percent screenings. The several tracks at the mine can provide storage space for 27 empty railroad cars.

In order to supply coal until such time as the development in the main tunnel should become adequate to supply the demand, work was resumed in the Negri tunnel and by January 1, 1923, it had been extended 225 feet beyond the former face. The original tippie at this working was slightly remodelled so that it would discharge into railroad cars on a branch of the coal spur built under the lower end. The grizzly was removed and hence this tippie delivers only run-of-mine coal.

The mine has two Pennsylvania return flue boilers, one of which is rated at 50 horsepower and has already been set up in a boiler house near the end of the main tippie; the other is rated at 40 horsepower and is shortly to be installed beside the first. There is also an "American" hoist having a 16-inch drum driven by two 7 by 10-inch steam cylinders

which is used for "spotting" railroad cars and for hoisting timbers up an inclined track at the end of the main tippie, and a "De Laval" steam turbine, direct-connected to a 40-ampere, 110 volt, "Western Electric" direct-current generator, which supplies lights for the tunnels and entries of the mine and for the living and office quarters. The Healy River Coal Corporation has also chartered a locomotive from the Alaska Railroad which is used exclusively on the Suntrana spur to deliver cars to and from the main line.

The main tunnels and entries are electrically lighted, but carbide lamps are used in the rooms. No "gas" has yet been discovered in any of the workings.

The coal falls by gravity for the most part from the breasts to the steel lined chutes at the bottom of the raises, although some assistance by shoveling is occasionally needed. From the chutes it is trammed by hand to the tippie. Mules are to be used for this purpose shortly, however. The track is made of 20-pound rails set at 24-inch gauge.

Except in the right Lathrop entry the mine is quite dry. Unused workings are regularly cleaned out by a man who has this as his sole duty.

During the month of December, 1922, the Suntrana mine employed an average of 35 men underground and 7 men on the surface. The production for this month was 5,243 short tons, an average of 175 tons per day, but during January, 1923, the average will probably be better than 250 tons per day and will probably continue to increase because of more advanced development work. The total production from October 26, 1922, to January 1, 1923, was 9,960 short tons.

The price of coal is based upon delivery in railroad cars at the main line of the Alaska Railroad. The following prices per long ton are charged for the various products: Screenings, \$2; run-of-mine, \$3; nut, \$3.50; and lump, \$4. The freight rate from Healy to Fairbanks is \$2 per ton and includes a charge of fifty cents per ton to cover the cost of transferring from standard to narrow gauge cars at Nenana, which will be obviated during the coming summer by the widening of the track from Nenana to Fairbanks to standard gauge. The freight rate from Healy to Anchorage is \$2.50 per ton and to Seward \$3.00.

The following analyses of coal from the Suntrana mine have been made by the Alaska station of the U. S. Bureau of Mines:

## ANALYSES OF SUNTRANA COAL

		Moisture	Ash	Volatile Matter	Fixed Carbon
Sample of 35 tons delivered to Alaska Railroad at Fairbanks, Feb. 1922.	As received	20.72	7.50	40.55	31.23
	Moisture free		9.46	51.15	39.39
	Moisture and ash free			56.50	43.50
Sample of 70 tons delivered to Alaska Railroad at Nenana February, 1922.	As received	19.81	7.57	41.36	31.26
	Moisture free		9.44	51.58	38.98
	Moisture and ash free			56.96	43.04
Sample of 400 tons used at Anchorage power plant March, 1922.	As received	19.86	8.28	39.19	32.67
	Moisture free		10.33	40.77	48.90
	Moisture and ash free			54.53	45.47

	Moisture	Ash	Volatile Matter	Fixed Carbon
Sample of 37 tons delivered to U.S.B.M. at Fairbanks December, 1922.	As received ..... 21.62	6.52	39.37	32.49
	Moisture free .....	8.32	50.23	41.35
	Moisture and ash free .....		54.79	45.21
Mine sample in No. 10 raise Negri tunnel January 15, 1923.	As received ..... 19.78	8.51	39.31	32.40
	Moisture free .....	10.60	49.00	40.40
	Moisture and ash free .....		54.81	45.19
Mine sample at breast Negri tunnel 640 feet from portal, Jan. 15, 1923.	As received ..... 20.12	4.73	41.57	33.58
	Moisture free .....	5.93	52.04	42.03
	Moisture and ash free .....		55.32	44.68
Mine sample in No. 3 raise, left Lathrop entry, January 15, 1923.	As received ..... 23.00	4.63	37.82	34.53
	Moisture free .....	6.05	49.11	44.84
	Moisture and ash free .....		52.27	47.73
Mine sample at breast of left Lathrop entry, 325 feet from main tunnel, Jan. 15, 1923.	As received ..... 24.28	4.83	37.03	33.86
	Moisture free .....	6.37	48.91	44.72
	Moisture and ash free .....		52.23	47.77

The first six analyses represent coal from the Bowen bed; the last two from the Lathrop bed. All of the samples were taken by the writer with the exception of the second, which was taken by the master mechanic of the northern division of the Alaska Railroad. The sample in number 10 raise, Negri tunnel, included nine feet of coal lying near the top of the Bowen bed. No partings occurred in this thickness and both roof and floor were coal. The sample at the breast of the Negri tunnel included eight feet six inches of coal without any partings. The roof and floor were also coal. The sample in number 3 raise left Lathrop entry included seven feet six inches of coal without partings. One foot of coal was left as roof below a soft white sandstone and the floor was bony shale. The sample at the breast of the left Lathrop entry included six feet four inches of clear coal above a bone floor. The roof was coal.

By comparison with those of the Peterson coal these analyses indicate a better grade of fuel; and this has been fully substantiated by actual use. There can be no question in this case as to its proper classification as sub-bituminous coal. An interesting comparison was made by the writer during April, 1922, with two coals from the Matanuska field in a series of boiler tests conducted at the Anchorage power plant of the Alaskan Engineering Commission (a). The results of these tests showed the following equivalent evaporation from and at 212° F., expressed in pounds of water evaporated per pound of fuel: Suntrana mine coal, 4.52 pounds; Evan Jones mine coal, 5.16 pounds; and Baxter mine coal, 5.03 pounds. In other words, the Suntrana coal has approximately 90 percent of the steaming value of the Matanuska fuels.

For domestic purposes its comparative value is more nearly equal. It is low in ash, ignites readily, burns freely, and a large percentage of lump coal can be put on the market, all of which are important advantages from the viewpoint of the domestic consumer.

(a)—Monthly Reports of Investigations, U. S. Bureau of Mines, 2412, Nov. 1922.

## LOCAL FREIGHT RATES, ALASKA (GOVERNMENT) RAILWAY

(In effect Oct. 1922.)

In less-than-carload lots—per 100 lbs.

	Ester Siding	Fox	Gilmore	Ridgetop	Olnes	Eldorado	Chatanika
FAIRBANKS TO—							
Coal in sacks .....	\$0.10	\$0.21	\$0.24	\$0.28	\$0.32	\$0.33	\$0.35
Dynamite, powder, etc. ....	0.32	0.68	0.76	0.90	1.00	1.06	1.10
Groceries, NOIBN.—							
(Highest rate — 1st Class) .....	0.16	0.34	0.38	0.45	0.50	0.55	0.55
Hay .....	0.12	0.25	0.28	0.33	0.37	0.39	0.41
Grain .....	0.10	0.21	0.24	0.28	0.32	0.33	0.35
Lumber, common .....	0.10	0.21	0.24	0.28	0.32	0.33	0.35
Machinery, mining: 4th Class — Single pieces or pkgs. not over 2,000 lbs. ....	0.10	0.21	0.24	0.28	0.32	0.33	0.35
Over 2,000 lbs. wt. ....		With heavy shipments, shipper must arrange for for loading and unloading					
General hardware NOIBN, 2nd Class....	0.14	0.29	0.32	0.38	0.43	0.45	0.47
Oils—distillate, gasoline, fuel, engine, etc. In drums .....	0.12	0.25	0.28	0.33	0.37	0.39	0.41

## FREIGHT RATES, ALASKA (GOVERNMENT) RAILWAY

(In effect October, 1922)

COAL in carload lots—40,000 lbs. minimum—per short ton.

	Nenana	Fairbanks	Chatanika
Broad Pass, Summit, or Colorado to .....	\$1.50	\$2.00	\$2.25
Healy, Lignite or Suntrana to .....	1.00	1.50	2.00

Additional to above rate there is a transfer charge at Nenana of \$ .50 per ton. This charge to cease after the completion of the bridge over the Tanana River.

WOOD—CARLOAD LOTS	Fox	Gilmore	Ridgetop	Eldorado	Chatanika
Bartlett to .....	\$1.50	\$1.50	\$1.65	\$1.80	\$1.80
Martin to .....	1.50	1.65	1.80	1.80	1.80
Cache to .....	1.65	1.65	1.80	1.90	1.90

Average 8 cords—128 cu. ft. per cord—to the carload.

Return freight rate on oil drums (Gauge 16 or thicker) to Seattle—4th Class.	From Fairbanks	From Gilmore
Less than carload lots .....	\$2.55 per 100 lbs.	\$2.62 per 100 lbs.
Carload lots 18,000 lb. min. ....	1.60 per 100 lbs.	1.65 per 100 lbs.

Additional to above is transfer charge over the Tanana River at Nenana of \$ .15 per 100 lbs. To cease after completion of bridge.

## FREIGHT RATES VIA ALASKA (GOVERNMENT) RAILWAY

(In effect Oct. 1922.)

In less-than-carload lots—per 100 lbs.

	SEWARD TO		ANCHORAGE TO				Fairbanks via Seward		Seattle to Fairbanks via Seward	
	Anch- orage	Fair- banks	Tai- keetna	Healy	Ne- nana	Fair- banks	Chat- anika	L.C.L. lot		
Coal in sacks	\$0.68	\$1.73	\$0.67	\$1.22	\$1.44	\$1.56	\$1.59	\$2.55	1.35	
Dynamite, powder, etc.	2.16	5.48	2.12	3.86	4.56	4.94	5.04	8.40	4.20	
Groceries, NOIEN —										
1st class	1.08	2.74	1.06	1.93	2.28	2.47	2.52	4.20	2.10	
4th class						1.56		2.55		
Hay, baled	0.80	2.03	0.47	0.86	1.01	1.10	1.12	*44.00	*34.20	
Grain	0.68	1.73	0.67	1.22	1.44	1.56	1.59	*49.50	*34.30	
Emigrants' movables, household goods, etc.										
Rel.	0.92	2.33	0.90	1.64	1.94	2.10	2.14	4.20	2.10	
Lumber, common	0.68	1.73	0.67	1.22	1.44	1.56	1.59	2.55	1.35	
Machinery, mining and dredge — 4th class—single pieces or pkgs., not over 4,000 lbs.	0.68	1.73	0.67	1.22	1.44	1.56	1.59	2.55	2.10	
From 4,000 to 6,000 lbs.								†3.00		
From 6,000 to 8,000 lbs.								†4.00		
From 8,000 to 10,000 lbs.								†5.00		
From 10,000 to 20,000 lbs.								†10.00		
Oils—fuel, distillate, gasoline, engine, etc.—3rd class in drums	0.80	2.03	0.78	1.43	1.69	1.83	1.86	2.95	2.10	
Trucks, tractors, general hardware, when billed with mining machinery										

Same rate applies as for mining machinery

There is an additional charge for transfer or rehandling at Nenana of \$0.15 per 100 lbs., which will cease after the completion of the bridge over the Tanana River.

\*—Per ton.

†—Per ton in addition to above rate.

## MINERAL PRODUCTION

The following tables of mineral production are taken from the publications of the U. S. Geological Survey, except as indicated by footnotes:

## VALUE OF TOTAL MINERAL PRODUCTION OF ALASKA

1880-1922

By Years—		By Substances	
1880-1890	\$ 4,686,714	1907	\$ 20,850,235
1891	916,920	1908	20,145,632
1892	1,098,400	1909	21,146,953
1893	1,051,610	1910	16,887,244
1894	1,312,567	1911	20,691,241
1895	2,388,042	1912	22,536,849
1896	2,981,877	1913	19,476,356
1897	2,540,401	1914	19,065,666
1898	2,587,815	1915	32,854,229
1899	5,706,226	1916	48,632,212
1900	8,241,734	1917	40,710,205
1901	7,010,838	1918	28,253,961
1902	8,403,153	1919	19,620,913
1903	8,944,134	1920	23,303,757
1904	9,569,715	1921	17,004,124
1905	16,480,762	1922 (a)	18,247,000
1906	23,378,428		
Total	\$496,725,913		

Gold	\$335,834,093
Copper	143,840,698
Silver	8,793,977
Coal	2,779,522
Tin	936,664
Lead	770,537
Antimony	237,500
Petroleum, marble, gypsum, quick-silver, platinum, etc.	3,532,922
Total	\$496,725,913

Note:—Figures for production in 1922, included in above totals, approximate only.

(a)—Preliminary estimate by U. S. Geol. Survey—Advance Statement, January 1, 1923.

## GOLD AND SILVER PRODUCED IN ALASKA 1880-1922

Year—	GOLD		SILVER	
	Quantity (fine ounces)	Value	Quantity (fine ounces)	Commercial Value
1880	967	\$ 20,000		
1881	1,935	40,000		
1882	7,256	150,000		
1883	14,561	301,000	1880 to 1887	10,320 \$ 11,146
1884	9,724	201,000		
1885	14,512	300,000		
1886	21,575	446,000		
1887	32,653	675,000		
1888	41,119	850,000	2,320	2,181
1889	43,538	900,000	8,000	7,490
1890	36,862	762,000	7,500	6,071
1891	43,538	900,000	8,000	7,920
1892	52,245	1,080,000	8,000	7,000
1893	50,213	1,038,000	8,400	6,570
1894	62,017	1,282,000	22,261	14,257
1895	112,642	2,328,500	67,200	44,222
1896	138,401	2,861,000	145,300	99,087
1897	118,011	2,439,500	116,400	70,741
1898	121,760	2,517,000	92,400	54,575
1899	270,997	5,602,000	140,100	84,276
1900	395,030	8,166,000	73,300	45,494
1901	335,369	6,932,700	47,900	28,598
1902	400,709	8,283,400	92,000	48,590
1903	420,069	8,683,600	143,600	77,843
1904	443,115	9,160,000	198,700	114,934
1905	756,101	15,630,000	132,174	80,165
1906	1,066,030	2,036,794	203,500	136,345
1907	936,043	19,349,743	149,784	98,857
1908	933,290	19,292,818	135,672	71,906
1909	987,417	20,411,716	147,950	76,934
1910	780,131	16,126,749	157,850	85,239
1911	815,276	16,853,256	460,231	243,923
1912	829,436	17,145,951	515,186	316,839
1913	755,947	15,626,813	362,563	218,988
1914	762,596	15,764,259	394,805	218,327
1915	807,966	16,702,144	1,071,782	583,393
1916	834,068	17,241,713	1,379,171	907,554
1917	709,049	14,657,353	1,239,150	1,021,060
1918	458,641	9,489,952	847,789	847,789
1919	455,984	9,426,032	629,708	705,273
1920	404,683	8,365,560	953,546	1,039,364
1921	390,558	8,073,540	761,085	761,085
1922	(a)	7,730,000	730,000	730,000
Totals		\$335,834,093		\$8,793,977

(a)—Preliminary estimate by U. S. Geol. Survey—Advance Statement, Jan. 1, 1923.

## COPPER PRODUCED IN ALASKA 1880-1922

Year—	Ore Mined (tons)	Copper Produced	
		Quantity (pounds)	Value
1880 .....		3,923	\$ 826
1881-1900 .....			
1901 .....		250,000	40,000
1902 .....	(a) 40,000	360,000	41,400
1903 .....		1,200,000	156,000
1904 .....		2,043,586	275,676
1905 .....	52,199	4,805,236	749,617
1906 .....	105,729	5,871,811	1,133,260
1907 .....	98,927	6,348,786	1,261,757
1908 .....	51,509	4,585,362	605,267
1909 .....	34,669	4,124,705	536,211
1910 .....	39,365	4,241,689	538,695
1911 .....	68,975	27,267,878	3,408,485
1912 .....	93,452	29,230,491	4,823,031
1913 .....	135,756	21,659,958	3,357,293
1914 .....	153,605	21,450,628	2,852,934
1915 .....	369,600	86,509,312	15,139,129
1916 .....	617,264	119,854,839	29,484,291
1917 .....	659,957	88,793,400	24,240,598
1918 .....	722,047	69,224,951	17,098,563
1919 .....	492,644	47,220,771	8,783,063
1920 .....	766,095	70,435,363	12,960,106
1921 .....	477,121	57,011,579	7,354,496
1922 .....	(b) 581,281	67,000,000	9,000,000
Total .....	5,560,195	739,454,296	\$143,840,698

(a)—Estimated.

(b)—Estimate by Mine Inspector.

## PLATINUM METALS PRODUCED IN ALASKA 1916-1922

Year—	QUANTITY		Value
	Crude Ounces	Fine Ounces	
1916 .....	12.0	8.33	\$ 700
1917 .....	81.2	53.40	5,500
1918 .....	301.0	284.00	36,600
1919 .....	579.3	569.52	73,663
1920 .....	1,493.4	1,478.97	160,117
1921 .....	57.0	40.00	2,670
1922 .....	(a)		
Totals .....	2,523.9	2,434.22	\$279,250

(a)—No production reported for 1922.

## TIN PRODUCED IN ALASKA 1902-1922

Year—	QUANTITY		Value	Year—	QUANTITY		Value
	Ore (Tons)	Metal (Tons)			Ore (Tons)	Metal (Tons)	
1902 .....	25	15	\$ 8,000	1913 .....	98	50	44,103
1903 .....	41	25	14,000	1914 .....	157.5	104	66,560
1904 .....	23	14	8,000	1915 .....	167	102	78,846
1905 .....	10	6	4,000	1916 .....	232	139	121,000
1906 .....	57	34	38,640	1917 .....	171	100	123,300
1907 .....	37.5	22	16,752	1918 .....	104.5	68	118,000
1908 .....	42.5	25	15,180	1919 .....	86	56	73,400
1909 .....	19	11	7,638	1920 .....	26	16	16,112
1910 .....	16.5	10	8,335	1921 .....	7	4	2,400
1911 .....	92.5	61	52,798	1922 .....	(a)		
1912 .....	194	130	119,600				
Totals .....			1,607.0	Totals .....	1,607.0	992	\$936,664

(a)—No production reported for 1922.

## LEAD PRODUCED IN ALASKA 1892-1922

Year—	QUANTITY (Tons)	Value	Year—	QUANTITY (Tons)	Value
1892 .....	30	\$ 2,400	1908 .....	40	3,360
1893 .....	40	3,040	1909 .....	60	5,934
1894 .....	35	2,310	1910 .....	75	6,600
1895 .....	20	1,320	1911 .....	51	4,590
1896 .....	30	1,800	1912 .....	45	4,050
1897 .....	30	2,160	1913 .....	6	528
1898 .....	30	2,240	1914 .....	28	1,344
1899 .....	35	3,150	1915 .....	437	41,118
1900 .....	40	3,440	1916 .....	820	113,160
1901 .....	40	3,440	1917 .....	852	146,584
1902 .....	30	2,460	1918 .....	564	80,088
1903 .....	30	2,520	1919 .....	687	72,822
1904 .....	30	2,580	1920 .....	875	140,000
1905 .....	30	2,620	1921 .....	759	68,279
1906 .....	30	3,420	1922 .....	(a)	40,000
1907 .....	30	3,180			
Total .....			Total .....		\$770,537

(a)—Preliminary estimate by U. S. Geol. Survey—Advance Statement, Jan. 1, 1923.

## ANTIMONY PRODUCED IN ALASKA 1915-1922

Year—	Quantity Crude Ore (tons)	Value
1915 .....	833	\$ 74,000
1916 .....	1,458	134,000
1917 .....	165	28,000
1918 .....	36	1,500
1919 .....	none	none
1920 .....	none	none
1921 .....	none	none
1922 .....	none	none
Totals .....	2,492	\$237,500

# COAL PRODUCED AND CONSUMED IN ALASKA, 1888-1922, IN SHORT TONS

Year—	Produced in Alaska, chiefly subbituminous and lignite. Short tons	Value	Imported from States, chiefly bituminous from Washington(a)	Total foreign coal, chief- ly bituminous from British Columbia(a)	Total coal con- sumed
1880-1896 .....	6,000	\$ 84,000	.....	.....	.....
1897 .....	2,000	28,000	.....	.....	.....
1898 .....	1,000	14,000	.....	.....	.....
1899 .....	1,200	16,800	10,000	b50,100	61,320
1900 .....	1,200	16,800	15,048	b56,623	72,871
1901 .....	1,300	15,600	24,000	b77,674	102,974
1902 .....	2,212	19,048	40,000	b68,363	110,575
1903 .....	1,447	9,782	64,626	b60,605	126,678
1904 .....	1,694	7,225	36,689	b76,815	115,198
1905 .....	3,774	13,250	67,713	b72,612	144,099
1906 .....	5,541	17,974	69,493	b47,590	122,624
1907 .....	10,139	53,600	46,246	b93,262	149,647
1908 .....	3,107	14,810	23,893	b86,404	113,404
1909 .....	2,800	12,300	33,112	69,046	104,958
1910 .....	1,000	15,000	32,098	58,420	91,518
1911 .....	900	9,300	32,255	61,845	95,000
1912 .....	355	2,840	27,767	68,316	96,438
1913 .....	2,300	13,800	69,066	56,430	127,796
1914 .....	.....	.....	41,509	46,153	87,662
1915 .....	1,400	3,300	46,329	29,457	77,186
1916 .....	13,073	52,317	44,934	53,672	111,679
1917 .....	53,955	265,317	58,116	56,589	168,660
1918 .....	75,606	411,850	51,520	37,986	165,112
1919 .....	60,674	342,547	57,166	48,708	166,548
1920 .....	61,111	355,668	38,128	45,264	144,503
1921 .....	76,817	496,394	24,278	33,776	134,871
1922 .....	84,403	c487,000	25,408	30,461	140,272
Totals .....	485,098	\$2,779,522	979,394	1,386,191	2,831,593

(a)—No figures on imports before 1899 are available.

(b)—By fiscal year ending June 30.

(c)—Estimated.

## ACCIDENTS

### CAUSES OF FATALITIES

During the year 1922 a total of five fatalities occurred in and about the mines and metallurgical plants of Alaska, as compared with twelve in 1921.

The causes that led to these fatalities are listed below:

1. Falls of rock or ore from roof .....	2
2. Fall of rock from slope in bulldozing chamber .....	1
3. Falling down raise .....	1
4. Collapse of scaffolding .....	1
Total .....	5

The total number of men employed in the industry during 1922 was approximately 4,000.

## MINE FIRE AT EVAN JONES COAL MINE

A serious underground fire broke out on the second or lower level of the Evan Jones coal mine in the Matanuska field on the afternoon of November 19th, 1922.

While the origin of the fire is not definitely known, it was probably due to the use of coal dust as tamping in blasting operations or to the ignition of a small pocket of gas by the black powder in use at the time.

Without doubt the fire started when blasts were ignited, shortly after the day shift had left the mine, which was at 4:30 p. m. The existence of the fire was not discovered until about 6:20 p. m., by which time a portion of the crew comprising the night shift had gone to their working places in other portions of the lower workings.

The existence of fire in the mine was first recognized by the night fire-boss, Jack Jones, whose prompt action and intelligent procedure in removing the night shift from the mine resulted in the saving of the lives of at least ten men. All men were safely removed from the mine. Fire-boss Jones realized that the fire was in the east workings on the No. 3 bed, second level, but was unable to place its exact position with certainty owing to the volume of smoke that occupied all the No. 3 bed workings. Following the removal of the night crew from the mine, efforts were made to explore the workings in order to locate the exact position of the fire and to control the situation by manipulating the ventilation. During these operations seven men, including the Superintendent, were overcome by gas. Through the prompt efforts of Fire-boss Jack Jones with a crew of six men those overcome were removed to the surface and resuscitated. The fire gained rapid headway and further efforts to enter the lower workings, which were continued throughout the night and the following morning, met with progressively less success and were finally abandoned early in the afternoon of November 20th.

Reports received do not indicate that any effort was made to effectually seal the lower workings during the early stages of the fire.

An attempt was made to communicate by telephone with Capt. Hill, local representative of the U. S. Bureau of Mines at Anchorage. Owing the poor 'phone connections, information regarding the fire did not reach him until 9:15 a. m. November 20th, and he was unable to reach the mine until about 2:30 p. m. of that date. At about that time a severe explosion occurred in the mine. This explosion was no doubt due to the ignition of a mixture of methane gas, generated by the fire, and air which entered the mine as a result of the lack of adequate stoppings.

Superintendent Jones reports that a 3-inch methane cap resulted when a safety lamp test of the return air was made at 1:00 p. m., at a point 15 feet inside the portal of the main haulage way, which constituted the return air course. Several minor explosions occurred later.

Following the arrival of Captain Hill at the mine he held a conference with the superintendent and owners of the mine. It was decided that at that time it was impossible to effectually control the fire by at-

tempting to seal the mine. Breathing apparatus was not available until nearly a week after the inception of the fire, and entry into the workings was therefore impossible. The caved condition of the upper workings, which had been carried up on the coal beds to the surface—overburden over a considerable distance, rendered it probable that air would reach the fire area despite any stoppings that might be built in sections of the mine that could at that time be reached without breathing apparatus. It was therefore decided to flood the mine.

Captain Hill took full charge of the situation and rendered effective service throughout the remainder of the fire-fighting operations and mine recovery work.

The only water available for use in flooding the mine was in a small lake, 3,300 feet distant from the portal of the hauling way and 150 feet lower in elevation. The property was not equipped with power or pumps suitable for meeting the situation. By telephoning to Anchorage, about 55 miles distant, Captain Hill was able to make arrangements with the Anchorage Fire Department whereby the La France fire truck, owned by the City of Anchorage, was immediately despatched by train to the Jones mine. A plank roadway leading from the Jonesville railway spur to the shore of the lake was built, connecting with a plank-covered log float constructed on the lake.

A pipe line made up of iron pipe, ranging from 4 inches to 2½ inches in diameter, and standard 2½-inch fire hose was laid from the float to the mine. Pumping from the lake was started 9:15 a. m. November 22nd and filling of the mine was completed December 6th. During the above operations the outside temperature ranged from 20° above to 10° below zero. It was found necessary to replace the iron pipe with canvas hose in order to prevent freezing of the line.

Explorations were started on November 28th, with a view to determine the procedure to be followed in the recovery of the mine. This work was commenced as soon as oxygen-breathing apparatus was available and a crew trained in its use. John J. Delahide, First Aid Miner, U. S. Bureau of Mines, who was at Seward when the fire occurred, hastened to the mine, upon call for assistance, and proceeded at once to assemble the breathing apparatus that had been stored at the Chickaloon Mine and to train a crew of local miners in its use.

The crew that wore breathing apparatus during the mine recovery operations consisted of John J. Delahide, Capt. W. P. T. Hill, Jack Jones, J. Smith, B. Leonard, J. Gustafson and J. Lucas. Mr. John G. Schoning, Foreman Miner in charge of the Mine Rescue Station of the U. S. Bureau of Mines at Seattle, who was called upon for assistance, left Seattle on November 22nd and reached Jonesville in time to render valuable assistance and advise in planning and conducting recovery operations.

Unwatering of the mine started on December 8th and was completed January 3rd.

The clearing and retimbering of the gangways on the lower level were completed to a sufficient extent to permit of the resumption of mining operations and coal production on January 5th, 1923.

Through the courtesy of Colonel Mears, Chairman of the Alaska Engineering Commission, a maintenance-of-way car was placed at the disposal of the rescue crew at Jonesville. This car served as their headquarters during the course of the flooding, dewatering, and recovery operations.

Oxygen breathing apparatus was in use a total period of thirty hours during the progress of the work.

Many sections of the mine entered by the rescue crew under Mr. Delahide's leadership were filled with hot and poisonous gases and caving ground was a frequent menace to the lives of the party.

Since the occurrence of the fire at the Evan Jones mine permissible explosives only have been in use in the mine and the use of open lights has been discontinued.



## SUMMARY OF ALL LODE-MINE AND MILL ACCIDENTS OCCURRING IN ALASKA DURING 1922.

Number of plants reporting	GROUP	Number of men employed	Number of shifts worked	RESULTS OF ACCIDENTS			TOTAL TIME LOST (Days)
				Fatal	Serious	Slight	
LODE MINES:							
30	Gold .....	590	188,843	2	35	48	2,067
12	Copper .....	493	164,279	2	31	78	1,690
2	Non-Metal .....	63	18,915	None	None	None	None
44	Sub-total			—	—	—	—
	Lode Mines	1,146	372,037	4	66	126	3,757
MILLS:							
14	Gold .....	204	69,914	None	4	17	158
2	Copper .....	259	95,229	1	5	34	429
16	Sub-total			—	—	—	—
	Mills .....	463	165,143	1	9	51	587
60	Grand Totals	1,609	537,180	5	75	177	4,344

## LIST OF ALL ACCIDENTS REPORTED FROM COAL MINES OF ALASKA FOR THE YEAR 1922, CLASSIFIED AS TO CAUSES AND RESULTS OF ACCIDENTS.

CAUSES	Killed	Permanent to- tal Disability-(A)	Permanent par- tial Disability-(B)	Temporary Disability-(C)		Total Injured
				Time lost more than 14 days	Time lost less than 14 days	
<b>Underground</b>						
1. Falls of roof coal, rock, etc.) .....	....	....	....	....	1	1
2. Falls of face or pillar coal.....	....	....	....	....	....	....
3. Mine cars and locomotives.....	....	....	....	1	1	2
4. Gas explosions and burning gas.....	....	....	....	1	1	2
5. Coal dust explosions.....	....	....	....	....	....	....
6. Explosives .....	....	....	....	....	....	....
7. Suffocation from mine gases.....	....	....	....	....	....	....
8. Electricity .....	....	....	....	....	....	....
9. Animals .....	....	....	....	....	....	....
10. Mining machines .....	....	....	....	....	2	2
11. Mine fires .....	....	....	....	....	....	....
12. Other causes .....	....	....	....	3	7	10
TOTAL .....	0	0	0	5	12	17
<b>Shaft</b>						
13. Falling down shafts or slopes.....	....	....	....	....	....	....
14. Objects falling down shafts or slopes	....	....	....	....	....	....
15. Cage, skip, or bucket.....	....	....	....	....	....	....
16. Other causes .....	....	....	....	....	....	....
TOTAL .....	0	0	0	0	0	0
<b>Surface</b>						
17. Mine cars and locomotives.....	....	....	....	....	....	....
18. Electricity .....	....	....	....	....	....	....
19. Machinery .....	....	....	....	....	....	....
20. Boiler explosions or bursting steam pipes .....	....	....	....	....	....	....
21. Railway cars and locomotives.....	....	....	....	....	....	....
22. Other causes .....	....	....	....	1	2	3
TOTAL .....	0	0	0	1	2	3
GRAND TOTAL .....	0	0	0	6	14	20

Average number of men employed underground ..... 96  
 Average number of men employed on the surface ..... 92  
 Total number of shifts underground ..... 27,760  
 Total number of shifts on the surface ..... 27,549  
 Total time lost on accounts of all accidents ..... 250 days.

(A).—Permanent total disability.—Loss of both legs, or arms, one leg and one arm, total loss of eyesight, paralysis, or other condition permanently incapacitating workman from doing any work of a gainful occupation.

(B).—Permanent partial disability.—Loss of one foot, leg, hand, eye, one or more fingers, one or more toes, any dislocation where ligaments are severed, or any other injury known in surgery to be permanent partial disability.

(C).—Under this head are included only those accidents which cause a loss of time more than the balance of the day or shift upon which the accident occurred.

LIST OF ALL ACCIDENTS REPORTED FROM GOLD MINES OF ALASKA  
FOR THE YEAR 1922, CLASSIFIED AS TO CAUSES  
AND RESULTS OF ACCIDENTS.

CAUSES	Killed	Permanent to- tal Disability-(A)	Permanent par- tial Disability-(B)	Temporary Disability-(C)		Total Injured
				Time lost more than 14 days	Time lost less than 14 days	
Underground						
Number killed or injured by:						
1. Fall of rock or ore from roof or wall	1	...	...	3	...	4
2. Rock or ore while loading at work- ing face or chute	1	...	2	5	9	17
3. Timber and hand tools	...	...	1	2	4	7
4. Explosives	...	...	...	...	...	...
5. Hauling system (mine cars, mine locomotives, breakags of rope, etc.)	...	...	...	6	5	11
6. Falling down chute, winze, raise or stope	...	...	...	2	1	3
7. Run of ore from chute or pocket	...	...	...	...	...	...
8. Drilling accidents (by machine or hand drills)	...	...	...	1	1	2
9. Electricity	...	...	...	...	1	1
10. Machinery (other than locomotives or drills)	...	...	1	...	...	1
11. Mine fires	...	...	...	...	...	...
12. Suffocation from natural gases	...	...	...	...	...	...
13. Inrush of water	...	...	...	...	...	...
14. Nails, splinters, etc.	...	...	...	...	19	22
15. Other causes	...	...	...	3	...	...
Total number killed or injured underground	2	...	4	22	40	68
Shaft Accidents						
Number killed or injured by:						
16. Falling down shafts	...	...	...	...	...	...
17. Objects falling down shafts	...	...	...	...	...	...
18. Breaking of cables	...	...	...	...	...	...
19. Overwinding	...	...	...	...	...	...
20. Skip, cage or bucket	...	...	...	...	1	1
21. Other causes	...	...	...	1	...	1
Total number killed or injured by shaft accidents	...	...	...	1	1	2
Surface Accidents						
(At surface yards and shops)						
Number killed or injured by:						
22. Mine cars and mine locomotives, gravity or aerial trams	...	...	...	2	...	2
23. Railway cars and locomotives	...	...	...	...	...	...
24. Run or fall of ore in or from ore bins	...	...	...	...	...	...
25. Falls of persons	...	...	...	1	...	1
26. Nails, splinters, etc.	...	...	...	...	...	...
27. Hand tools, axes, bars, etc.	...	...	...	1	...	1
28. Electricity	...	...	...	...	...	...
29. Machinery	...	...	...	2	1	3
30. Other causes	...	...	...	2	6	8
Total number killed or injured by surface accidents	...	...	...	8	7	15
GRAND TOTAL	2	...	4	31	48	85

- (A).—Permanent total disability.—Loss of both legs, or arms, one leg and one arm, total loss of eyesight, paralysis, or other condition permanently incapacitating workman from doing any work of a gainful occupation.
- (B).—Permanent partial disability.—Loss of one foot, leg, hand, eye, one or more fingers, one or more toes, any dislocation where ligaments are severed, or any other injury known in surgery to be permanent partial disability.
- (C).—Under this head are included only those accidents which cause a loss of time more than the balance of the day or shift upon which the accident occurred.

Average number of men reported as employed at all Gold Mines during 1922 ..... 590

Total number of shifts underground ..... 128,159

Total number of shifts on surface ..... 60,684

Total time lost on account of all accidents at Gold Mines ..... 2,067 days.

LIST OF ALL ACCIDENTS REPORTED FROM COPPER MINES OF ALASKA  
FOR THE YEAR 1922, CLASSIFIED AS TO CAUSES  
AND RESULTS OF ACCIDENTS.

CAUSES	Killed	Permanent to- tal Disability-(A)	Permanent par- tial Disability-(B)	Temporary Disability-(C)		Total Injured
				Time lost more than 14 days	Time lost less than 14 days	
<b>Underground</b>						
Number killed or injured by:						
1. Fall of rock or ore from roof or wall	1	—	—	1	2	4
2. Rock or ore while loading at work- ing face or chute	—	—	—	7	16	23
3. Timber or hand tools	—	—	—	—	2	2
4. Explosives	—	—	—	—	1	1
5. Haulage system (mine cars, mine locomotives, breakage rope, etc)	—	—	—	4	13	17
6. Falling down chute, winze, raise or slope	1	—	1	1	—	3
7. Run of ore from chute or pocket	—	—	—	—	—	—
8. Drilling accidents (by machine or hand drills)	—	—	—	2	6	8
9. Electricity	—	—	—	—	1	1
10. Machinery (other than locomotives or drills)	—	—	—	—	—	—
11. Mine fires	—	—	—	—	—	—
12. Suffocation from natural gases	—	—	—	—	—	—
13. Inrush of water	—	—	—	—	—	—
14. Nails, splinters, etc.	—	—	—	—	—	—
15. Other causes	—	—	—	10	13	23
Total number killed or injured underground	2	—	1	25	51	82
<b>Shaft Accidents</b>						
Number killed or injured by:						
16. Falling down shafts	—	—	—	—	—	—
17. Objects falling down shafts	—	—	—	—	—	—
18. Breaking of cables	—	—	—	—	—	—
19. Overwinding	—	—	—	—	—	—
20. Skip, cage or bucket	—	—	—	2	—	2
21. Other causes	—	—	—	—	1	1
Total number killed or injured by shaft accidents	—	—	—	2	1	3
<b>Surface Accidents</b>						
(At surface yards and shops)						
Number killed or injured by:						
22. Mine cars and mine locomotives, gravity or aerial trams	—	—	—	—	7	7
23. Railway cars and locomotives	—	—	—	—	—	—
24. Run or fall of ore in or from ore bins	—	—	—	—	—	—
25. Falls of persons	—	—	—	—	4	4
26. Nails, splinters, etc.	—	—	—	—	1	1
27. Hand tools, axes, bars, etc.	—	—	—	—	—	—
28. Electricity	—	—	—	—	—	—
29. Machinery	—	—	—	1	—	1
30. Other causes	—	—	—	2	8	10
Total number killed or injured by surface accidents	—	—	—	3	20	23

## Open Pit Accidents

Number killed or injured by:

31. Falls or slides of rock or ore	—	—	—	—	—
32. Explosives	—	—	—	1	1
33. Haulage system (cars, locomotives, etc.)	—	—	—	—	—
34. Steam shovels	—	—	—	—	—
35. Falls of persons	—	—	—	1	1
36. Falls of derrick, booms, etc.	—	—	—	—	—
37. Run or fall of ore in or from ore bins	—	—	—	—	—
38. Machinery (other than locomotives, or steam shovels)	—	—	—	—	—
39. Electricity	—	—	—	—	—
40. Hand tools	—	—	—	—	—
41. Other causes	—	—	—	2	2
Total number killed or injured by open pit accidents	—	—	—	1	3
GRAND TOTAL	2	—	1	31	78

(A).—Permanent total disability.—Loss of both legs, or arms, one leg and one arm, total loss of eyesight, paralysis, or other condition permanently incapacitating workman from doing any work of a gainful occupation.

(B).—Permanent partial disability.—Loss of one foot, leg, hand, eye, one or more fingers, one or more toes, any dislocation where ligaments are severed, or any other injury known in surgery to be permanent partial disability.

(C).—Under this head are included only those accidents which cause a loss of time more than the balance of the day or shift upon which the accident occurred.

Average number of men reported as employed at all Copper Mines during 1922 493

Total number of shifts underground 119,868

Total number of shifts on surface 44,411

Total time lost on account of all accidents at Copper Mines during 1922 1,690 days

LIST OF ALL ACCIDENTS REPORTED FROM GOLD MILLING PLANTS OF ALASKA FOR THE YEAR 1922, CLASSIFIED AS TO CAUSES AND RESULTS OF ACCIDENTS.

CAUSES	Killed	Permanent total Disability-(A)	Permanent partial Disability-(B)	Temporary Disability-(C)		Total Injured
				Time lost more than 14 days	Time lost less than 14 days	
1. Haulage system (Cars, motors, etc.)	...	...	...	...	2	2
2. Railway cars and locomotives	...	...	...	...	...	...
3. Crushers, rolls or stamps	...	...	...	...	...	...
4. Tables, jigs, etc.	...	...	...	...	...	...
5. Other machinery	...	...	...	...	...	...
6. Falls of persons	...	...	...	1	4	5
7. Suffocation in ore bins	...	...	...	...	...	...
8. Falling objects (rocks, timbers, etc.)	...	...	...	...	3	3
9. Cyanide or other poisoning	...	...	...	...	...	...
10. Scalding (steam or water)	...	...	...	...	...	...
11. Electricity	...	...	...	...	...	...
12. Hand tools, axes, bars	...	...	...	...	2	2
13. Nails and splinters	...	...	...	...	1	1
14. Flying pieces of rock from sledging or crushing	...	...	...	...	...	...
15. Other causes	...	...	...	3	5	8
Total killed or injured at Gold Mills	0	0	0	4	17	21

(A).—Permanent total disability.—Loss of both legs, or arms, one leg and one arm, total loss of eyesight, paralysis, or other condition permanently incapacitating workman from doing any work of a gainful occupation.

(B).—Permanent partial disability.—Loss of one foot, leg, hand, eye, one or more fingers, one or more toes, any dislocation where ligaments are severed, or any other injury known in surgery to be permanent partial disability.

(C).—Under this head are included only those accidents which cause a loss of time more than the balance of the day or shift upon which the accident occurred.

Average number of men reported as employed at all Gold Mills during 1922 ..... 204

Total number of shifts worked ..... 69,914

Total time lost on account of all accidents at Gold Mills ..... 158 days.

LIST OF ALL ACCIDENTS REPORTED FROM ALL COPPER MILLING PLANTS OF ALASKA FOR THE YEAR 1922, CLASSIFIED AS TO CAUSES AND RESULTS OF ACCIDENTS.

CAUSES	Killed	Permanent to- tal Disability-(A)	Permanent par- tial Disability-(B)	Temporary Disability-(C)		Total Injured
				Time lost more than 14 days	Time lost less than 14 days	
Ore Dressing and Milling Accidents						
1. Haulage system (Cars, motors, etc.)	....	....	....	....	1	1
2. Railway cars and locomotives	....	....	....	....	....	....
3. Crushers, rolls or stamps	....	....	....	....	2	2
4. Tables, jigs, etc.	....	....	....	1	....	1
5. Other machinery	....	....	....	....	....	....
6. Falls of persons	....	....	....	....	....	....
7. Suffocation in ore bins	....	....	....	....	....	....
8. Falling objects (rocks, timbers, etc.)	....	....	....	....	1	1
9. Cyanide or other poisoning	....	....	....	....	....	....
10. Scalding (steam or water)	....	....	....	....	....	....
11. Electricity	....	....	....	....	....	....
12. Hand tools, axes, bars	....	....	....	....	....	....
13. Nails and splinters	....	....	....	....	....	....
14. Flying pieces of rock from sledging or crushing	....	....	....	....	....	....
15. Other causes	....	....	....	....	....	....
Total killed or injured by ore dressing and milling accidents	0	0	0	1	4	5
Auxiliary Works Accidents. (Yards, shops construction, etc.)						
31. Haulage systems, cars, motors, etc.	....	....	....	1	1	2
32. Railway cars and locomotives	....	....	....	....	....	....
33. Falls of persons	....	....	....	....	6	6
34. Falling objects, (rocks, timbers, etc.)	....	....	....	2	7	9
35. Nails, splinters, etc.	....	....	....	....	1	1
36. Hand tools, axes, bars, etc.	....	....	....	....	2	2
37. Electricity	....	....	....	....	....	....
38. Machinery	....	1	....	....	2	3
39. Failure of ladder, scaffold or other support	1	....	....	....	....	1
40. Handling hot materials	....	....	....	....	....	....
41. Other causes	....	....	....	....	11	11
Total killed or injured by auxil- iary works accidents	1	0	1	3	30	35
GRAND TOTAL	1	0	1	4	34	40

A LIST OF THE FATAL ACCIDENTS WHICH OCCURRED AT THE  
MINES AND ORE DRESSING PLANTS OF ALASKA  
DURING THE YEAR 1922

April 2—VINCENT JURMAN, Austrian, miner, age 30 years, employed by the Kennecott Copper Corporation at their Beatson Mine at Latouche, was killed by slipping on the ladder he was descending and falling down a raise and into a stope below.

The following statement is made by Mr. Jas. Fozard, Superintendent of the Beatson Mine:

"Beyond a doubt Jurman was walking down this raise with his back to the ladder, which, as I have since understood from the men, he was in the habit of doing; and, further, a particular friend of his, by name of Max Saull, stated that he had cautioned Jurman about this in many instances.

"We had a serious accident happen, once before, to a man walking down the raise back to the ladder and this feature has been taken up and discussed at nearly every Safety-First meeting and warnings issued by the foremen against the practice."

The following descriptions of the accidents which caused Jurman's death are given in affidavits by Mr. Fred M. Radel, Mine Foreman and Mr. John A. Richards, Mine Engineer, who were both present when the accident occurred:

Mr. Radel says: "Jurman was working in what is known as 205 No. Stope Raise at a point about 60 feet above the main level. This is a 45 degree raise, equipped with good ladders and extends below the main level for a distance of approximately 100 feet into what is known as 205 Stope.

"On returning to work in the afternoon, Jurman went up this raise to blast four holes. Mr. J. A. Richards, the Mine Engineer, and myself were standing by this raise on the main level, waiting for Jurman to light his holes and descend. I called to him, asking when he intended to blast, and he answered 'Right now,' so I told him I would wait until he came down. In about half a minute I looked up the raise and could see by his light that he was coming down the ladder. I stepped back from under the raise and in a few seconds something came past me, which I thought was Jurman and I also saw a box and two or three sticks of powder rolling by, which, no doubt, Jurman had left over when loading his round and which he was returning to the level.

"Richards and myself started to the 100-ft. level, Richards preceding me. At the 100-ft. level Richards went into one part of the stope where he thought the body would roll to, where it was found and I investigated another part and during this time the shots went off. None of the rock went to the part where Jurman was found. He was still breathing when we placed him on the stretcher and rushed him to the hospital; however, died shortly before reaching the hospital.

"My opinion is that Jurman was walking down the ladder with his back to the ladder instead of facing it and his heel slipped from the round, which let him fall, causing his death."

Mr. Richards says: "The following is a statement of what I observed in connection with the death of Vincent Jurman, who was killed on April 11, 1922, by falling down 205 North Stope Raise.

"Mr. Radel, Mine Foreman, and myself were on the main level in a small drift which meets the raise and had just called up to him and asked when he was going to blast. He answered 'I am going to blast right away.'

"About a half minute after this, two or three pieces of powder and a scraper came down the raise and Mr. Radel and I at once called to see if Jurman had fallen.

"Upon receiving no answer we went to the 100 level where we found him in the stope near the start of the raise.

"The raise extends above the main level 65 feet at a 45 degree slope. The raise below the main level is 135 feet long at a 56 degree slope.

"It is my opinion that Jurman slipped from the ladder as he was leaving the face after spitting the fuse."

August 28—TOM KATOFF, Russian, miner, single, age 26 years, employed by the Kennecott Copper Corporation at their Beatson Mine at Latouche, was killed by being struck on the head and back by a piece of soft gouge, weighing about fifty pounds, which fell from the back of the stope in which he was working.

The following details concerning the accident are given in an affidavit by Nick Orfandis, Katoff's partner, who was present at the time of the occurrence:

Orfandis says: "That on August 28, 1922, while in the employ of the Kennecott Copper Corporation at Latouche, Alaska, he and Tom Katoff were loading a hole in a stope in the mine known as 205-A North Hanging Wall Stope, and that while he was tamping powder in the hole and Tom Katoff was cutting powder, a piece of soft gouge, weighing about fifty pounds dropped about 10 feet and struck said Tom Katoff in the head and back. He further states that the above mentioned accident occurred about 3:30 P. M., and that immediately after Tom Katoff was struck with the chunk of rock he went for help, a stretcher was secured and the said Tom Katoff was taken to the hospital."

The following statement appears in an affidavit by F. M. Radel, Mine Foreman: "On the morning of August 28, 1922, I was in stope raise and told both Katoff and his partner, Orfandis, about springing some holes. I did not go back any more during the day. At 3:30 P. M., Tom Lain, Mine Engineer, rang me up telling me that Tom Katoff was hurt. I immediately went up to mine. The men were carrying Katoff out of mine when I reached there. We took him to the hospital. I went back to working place to find out how the accident occurred from his partner, Orfandis. I examined the back where the soft gouge came off that struck Katoff. Orfandis told me they looked twice or more each shift at back of raise to find out if there were any loose because when springing holes it shakes the ground. I saw the rock on ground that struck Katoff, and I would say that about fifty pounds of rock fell on Katoff."

September 10—CARL STATTLE, naturalized American, pipe-fitter and plumber, age 33 years, employed by the Kennecott Copper Corporation at their National Creek camp at Kennecott, was instantly killed as a result of a double accident whereby the scaffolding upon which

he was standing collapsed under the impact of a falling pipe fitting, thus precipitating him to the floor thirty feet below and he was struck on the head by the pipe fitting after he had fallen to the floor.

The following account of the accident is given in an affidavit by Donald Oliver, fellow-workman with Stattel: "Robert Fitzgerald, Ole Peterson and myself was instructed to help Carl Stattel remove an old pipe header over the trust cords in boiler plant, which was about 30 feet from the boiler room floor. The pipe header consisted of 6" pipe and fittings, was about 4 feet long and weighed about 300 pounds. About six inches under the pipe header was a temporary staging on which Fitzgerald, Stattel and myself was working on to remove the flange bolts. Stattel was in the center, Fitzgerald on one end and myself on the other. Before the three of us removed the flange bolts, Stattel wired the the pipe header to the rafters above. Immediately after the flange bolts had been removed, Stattel started cutting the wires by hammering the wires over the pipe and had cut two wires when I said to Carl to wait until I could secure the rope I was putting around the pipe header. He paid no attention to me but gave the wires another blow. The pipe then fell onto the staging the three of us was standing on, taking it out from under us. Carl fell to the boiler room floor, the pipe header following him down and striking him on the head. Fitzgerald fell only about 4 feet and caught himself on some insulated electric cable. As soon as the staging started from under me I was lucky enough to grab hold of a  $\frac{3}{4}$ " trust rod with my left hand and save myself. I do not know what Carl was figuring on unless he intended to drop the header on the staging first, before putting on the ropes to lower it down. However, Fitzgerald and myself was figuring to secure it with a rope first before cutting the wires but Stattel was in charge of the job."

September 25--OBREN ODOLOVICH, Servian, contractor, single, age 30 years, employed by the Alaska-Juneau Gold Mining Company at their mine at Juneau, was fatally injured by being caught by a fall of rock that had been "hung up" in the throat of a bull-doizing chamber.

The following statement as to the details of the accident are contained in an affidavit by Alex Zibio, who was working under Odolovich's direction at the time the latter was injured: "Affiant states that at or about 2:10 o'clock A. M. on the 25th day of September 1922, he was bull-doizing at No. 45 bull-doizing chamber in the Alaska-Juneau Mine. Obren Odolovich, who had charge of the bulldozing crew on that shift came where he was at No. 45 bull-doizing chamber and said 'How is it coming,' affiant answered 'Pretty tough, the rocks are hanging up,' then affiant went to the drift to get some powder and in about one minute he heard the rocks coming down and then heard Odolovich groaning and he called for help and went to No. 42 and No. 44 bulldozing chambers to get the men who were working there; when he returned he found Obren Odolovich between the grizzly bars with his feet towards the wall and some large rocks over his chest and side which was holding him against the grizzly bar. He was removed from underneath the rocks in about fifty minutes and taken to the Hospital at Juneau, Alaska."

November 9--ED BERG, Finlander, machine man, single, aged 36 years, employed by the Alaska-Juneau Gold Mining Company at their mine at Juneau was fatally injured by being struck by rock loosened by a recent blast.

The accident is described as follows in an affidavit by Hugo Peterson, partner of Berg at the time he was injured: "Affiant states that on the 9th day of November, 1922, at or about 2:00 o'clock P. M., he and one Ed Berg were working at No. 490 Raise, Chute Station, they set off a blast at the chute station and waited about 40 minutes for the powder smoke to clear away, then they went to the chute station where they blasted and affiant told Ed Berg to go to the drift and get a bar to bar down some loose rock that appeared to be hanging up; Ed Berg went for the bar, came back and as he was passing and alongside of affiant a large rock fell from the roof, striking Ed Berg on the left side of his head and arm and at the same time the rock struck on a plank that he was standing on, throwing him down and in the mean time the rock kind of rolled over his head and shoulders. Affiant immediately called for help and the injured was removed from under the rock and taken to St. Ann's Hospital."