

R. I. 3942

SEPTEMBER 1946

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
J. A. KRUG, SECRETARY

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BUREAU OF MINES  
R. R. SAYERS, DIRECTOR

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REPORT OF INVESTIGATIONS

EXPLORATION OF THE COPPER-SULFUR DEPOSIT  
KHAYYAM AND STUMBLE-ON PROPERTIES  
PRINCE OF WALES ISLAND, ALASKA



BY

EARL L. FOSSE

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By Earl L. Fosse<sup>2/</sup>

CONTENTS

	<u>Page</u>
Introduction.....	1
Acknowledgments.....	2
Location and accessibility.....	2
Physical features and climate.....	3
History, ownership, and production.....	3
Description of the deposit.....	4
General geology.....	4
Mineral deposits at Khayyam.....	4
Mineral deposits at Stumble-On.....	4
Mine development.....	5
Sampling and analyses.....	7
Work done by the Bureau of Mines.....	8

INTRODUCTION

Preliminary examination of the Khayyam mine indicated that greater reserves of copper might be found by trenching, sampling, detailed geological and topographical mapping, and diamond drilling. The deposit seemed to be a potential source of sulfur, also, for use in the manufacture of paper pulp.

Formal examination of the Khayyam mine by the Bureau of Mines was a follow-up of a preliminary examination made by W. S. Wright and the author on October 19-21, 1944. John Reed and W. S. Twanhofel, of the Geological Survey, visited the property during the summer of 1943 and suggested that the prospect be examined further.

Preliminary examination of the Stumble-On claim was made July 1-3, 1945, concomitant with the formal examination of the Khayyam mine  $1\frac{1}{2}$  miles to the west.

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1/ The Bureau of Mines will welcome reprinting of this paper provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 3942."

2/ Assistant mining engineer, Bureau of Mines, Juneau, Alaska.

## ACKNOWLEDGMENTS

In its program of exploration of mineral deposits, the Bureau of Mines has as its primary objective the more effective utilization of our mineral resources to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each exploratory project as soon as practicable after its conclusion. The Mining Branch, Lowell B. Moon, chief, conducts preliminary examinations, performs the actual exploratory work, and prepares the final report. The Metallurgical Branch, R. G. Knickerbocker, chief, analyzes samples and performs beneficiation tests. Both these branches are under the supervision of Dr. R. S. Dean, assistant director.

Special acknowledgment is due Robert S. Sanford, acting chief, Alaska Division, Mining Branch, for his help in the preparation of this report and during the project work.

## LOCATION AND ACCESSIBILITY

The Khayyam property is situated at 55° 18' north latitude and 132° 24' west longitude on Prince of Wales Island in Southeastern Alaska. (see fig. 1.) The mine adit is 2,350 feet above sea level, near the summit of a mountain ridge, and 2.8 miles in an airline southwest of the head of McKenzie Inlet, a southern branch of Skowl Arm. Skowl Arm is navigable by ocean-going vessels to the mouth of McKenzie Inlet, where reefs and rocky islands limit the channel width to 50 yards. Beyond this point the inlet widens to nearly half a mile. Coast and Geodetic Survey chart 8142 indicates from 12 fathoms of water at this narrow neck to more than 30 fathoms throughout the remainder of McKenzie Inlet. The old ore bunker and dock at the head of the inlet are beyond repair. A new ore bunker and dock would have to be built if a large-scale mining operation were established.

The mine can be reached by trail along the western ridge that lies on the west bank of Omar Creek. The trail is approximately  $4\frac{1}{2}$  miles in length. The grade is rather steep to an elevation of 1,500 feet, but the last  $2\frac{1}{2}$  miles can be traveled over gentle slopes along the crest of the ridge.

Ketchikan is 30 miles by air and 42 miles by water from the head of McKenzie Inlet. Food, hardware, fuel oil, lumber, and explosives can be purchased at Ketchikan and delivered by boat to McKenzie Inlet. By using an airplane, all small equipment and camp supplies could be using an airplane, all small equipment and camp supplies could be dropped with cargo parachutes near the mine.

Ore can be transported from McKenzie Inlet to the smelter in two ways - by small boat to Ketchikan, whence it would have to be transhipped to Seattle or Tacoma, or by ocean-going power barges direct from the ore bunkers in McKenzie Inlet to the docking facilities of the smelter in Tacoma. The freight rate from Ketchikan to Tacoma on ore worth \$60 a ton or less is \$4.50 plus a 16 percent surcharge. Wharfage is \$2.20 a ton at Ketchikan, and at Seattle it is \$1.40 a ton if cargo is transferred to open railroad cars. Marble was transported by barge from Dall Island, Alaska, to Seattle at \$0.90 a ton in company-owned barges.

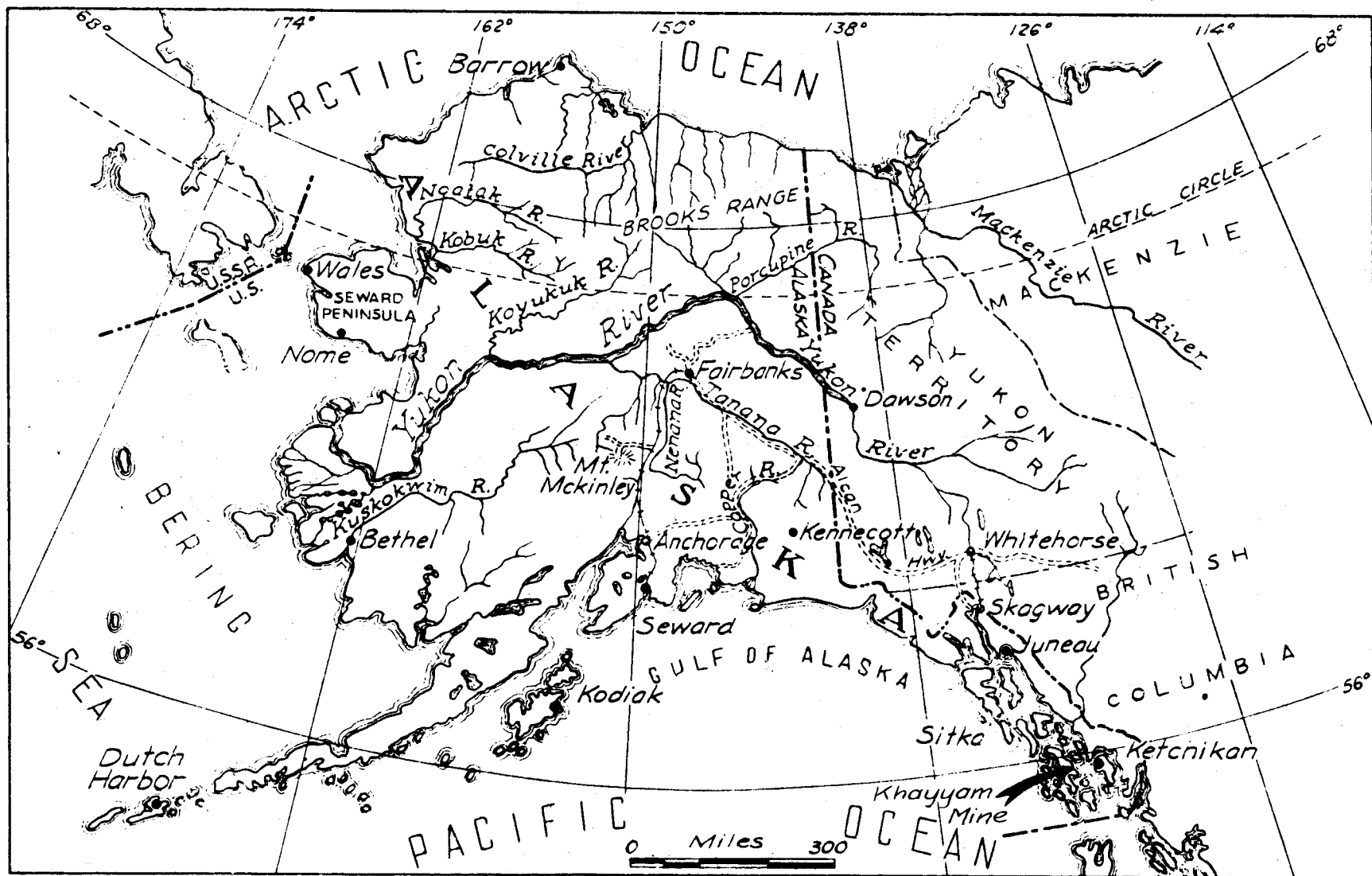


FIG. I.- INDEX MAP SHOWING LOCATION OF KHAYYAM MINE

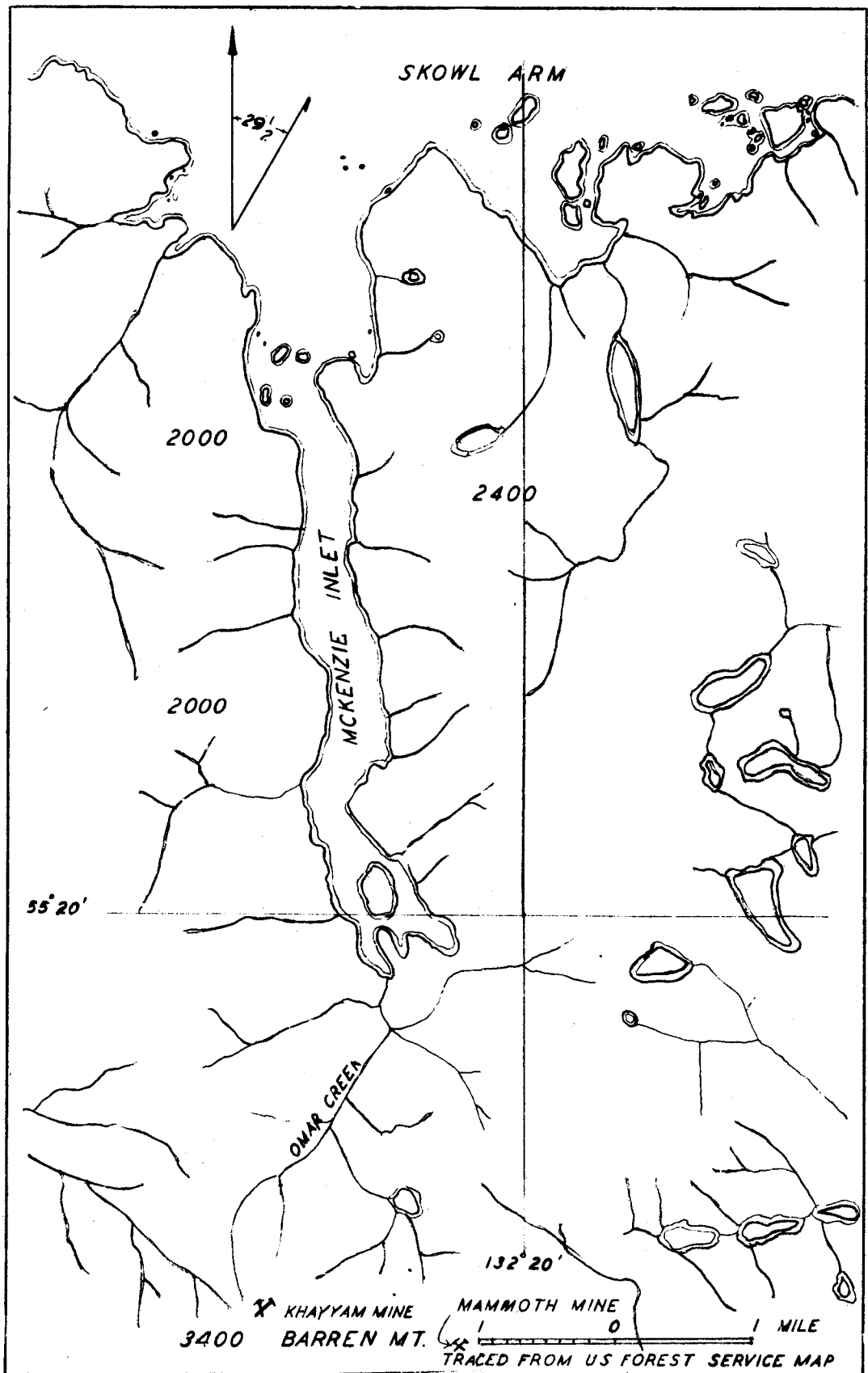


FIG. 2.—KHAYYAM MINE PRINCE OF WALES ISLAND S.E. ALASKA

The old surface tram on the west bank of Omar Creek crossed the creek about three-quarters of a mile from the beach and followed the large U-shaped basin for  $1\frac{1}{2}$  miles at a very moderate grade, to a point at an altitude of 1,200 feet, where it joined a mile-long aerial tram to the mine. The basin is fairly clear of timber, and there are numerous long areas of open muskeg.

The Stumble-On claim is at an altitude of 1,100 feet about three-quarters of a mile east of the junction of the aerial tram and surface tram of the Khayyam mine. A puncheon trail that once lead from McKenzie Inlet to the property is no longer safe for travel, as the foundation has rotted away.

#### PHYSICAL FEATURES AND CLIMATE

At the head of McKenzie Inlet, a U-shaped basin lies between mountain ridges whose summit elevations range from 2,000 to 3,500 feet. (See fig. 2.) The valley is bound on the east, south, and west by steep slopes that bear the vestiges of glaciation. Near the crest of the flat ridge between Skowl Arm and Cholmondeley Sound are small glacial lakes, and a few hundred feet west of the Khayyam mine other small lakes are to be found.

The lower hillsides to an elevation of about 1,500 feet are covered with a heavy stand of spruce, hemlock, and cedar and a dense undergrowth of alder, willow, cottonwood trees, berry bushes, and devil's club. Adequate timber is available for all mining and construction needs. Above this altitude the vegetation is confined to small patches of scrub timber and open muskegs, and above 2,000 feet to various lichens.

The average precipitation is 151 inches a year. Available records over a 35-year period indicate a mean winter temperature at Ketchikan of  $34.3^{\circ}$  F. and a mean summer temperature of  $51.4^{\circ}$  F. Mean seasonal temperatures at the Khayyam mine, 2,300 feet higher, would be a few degrees lower.

#### HISTORY, OWNERSHIP, AND PRODUCTION

The Khayyam property was first located in 1899, and from 1901 to 1905 most of the mine development, consisting of adits, crosscuts, drifts, shafts, and trenches, was accomplished between 2,000 to 2,500 feet. A surface tram from the beach  $2\frac{1}{3}$  miles in length connected with an aerial tram 1 mile in length to transport the ore to tidewater. This work was done by the Omar Mining Co., which suspended operations in 1906 but resumed them in 1907 for 4 months. Nothing is known of the status of the property until 1916, when some development work was done by Fred Heckman & Co. of Ketchikan. In 1937, the property was located by Harry A. Townsend for Texas Gulf Sulphur, but it is understood that the two claims recorded were later abandoned. The Khayyam mine has since reverted to the public domain. The Omar Mining Co. production records are not available, and nothing has been produced since this company relinquished the mine.

Information is meager regarding the original ownership and development of what is now known as Stumble-On claim. Work was in progress from July to October 1907, during which time two adits were driven and some trenches and open cuts were excavated on the strike of the ore body. The prospect was then known as the Mammoth and comprised two claims. A surface tram about  $2\frac{1}{2}$  miles long connected the property with the head of McKenzie Inlet.

In 1939, George A. Brown of Ketchikan, relocated the Mammoth claims, but later he relinquished the property.

The prospect was relocated in September 1945 and renamed the Stumble-On claim by Jack E. Allen and Joseph F. Angelson, both of Ketchikan.

## DESCRIPTION OF THE DEPOSIT

### General Geology

The country rock exposed around the shores of McKenzie Inlet are composed largely of a complex of dioritic and granitic intrusives. These intrusives invade the older limestone and greenstone-schist strata exposed along the north shore of the inlet and to the south in Cholmondeley Sound. In the vicinity of the Khayyam mine, the diorite has been altered to hornblende gneiss, into which the ore deposits have been intruded along shear planes parallel in strike and coinciding in dip with the schistosity of the country rock. Interbanded with the hornblende gneiss are belts of siliceous gneiss and quartzitic schist. The trend of the entire structure ranges from N. 75° W. to N. 85° W. and the dip from 80° N. to vertical. Several diabase dikes intrude the gneiss at a slight angle to the schistosity but apparently have no bearing on the formation of the ore deposits.

### Mineral Deposits at the Khayyam Mine

Lenses of massive iron and copper sulfides between gneissic bands form a zone of mineralization 10 to 260 feet wide and 1,100 feet long. In places, the ore lenses outcrop; in others, the sulfide minerals are covered by a thin limonite gossan. Underground workings show that nearly vertical lenses 6 to 27 feet wide have been extracted above the Powell adit, as indicated in figures 3 and 4. The western limit of mineralization in the Khayyam mine is defined by a fault with a strike nearly normal to the ore lenses and a dip ranging from 80° southeast to vertical. Another fault, having a strike of N. 4° W. and dip of 75° west, occurs 400 feet to the west. The mineral content of the lenses is chiefly pyrite with chalcopyrite, pyrrhotite, some sphalerite, and magnetite, and minor amounts of gold and silver. Quartz is disseminated throughout. The contacts of the ore masses with the gneiss are usually well-defined.

### Mineral Deposits at the Stumble-On Claims

In the vicinity of the Stumble-On prospect, the diorite has been altered to hornblende gneiss, into which the ore deposit has been intruded along a shear plane parallel in strike and coinciding in dip with the banding of the gneiss, the trend of the structure being N. 75° W. and the dip 80° north, and the average width 20 feet. The richer values are concentrated along the hanging wall across a two-foot width.<sup>3/</sup> The ore mass is composed of pyrite, chalcopyrite, pyrrhotite, some sphalerite, magnetite, gold and silver with quartz, calcite, and chlorite occurring as gangue minerals.

<sup>3/</sup> Wright, F. E., and Wright, C. W., The Ketchikan and Wrangell Mining Districts, Alaska; Geol. Surv. Bull. 347, 1908, p. 137.

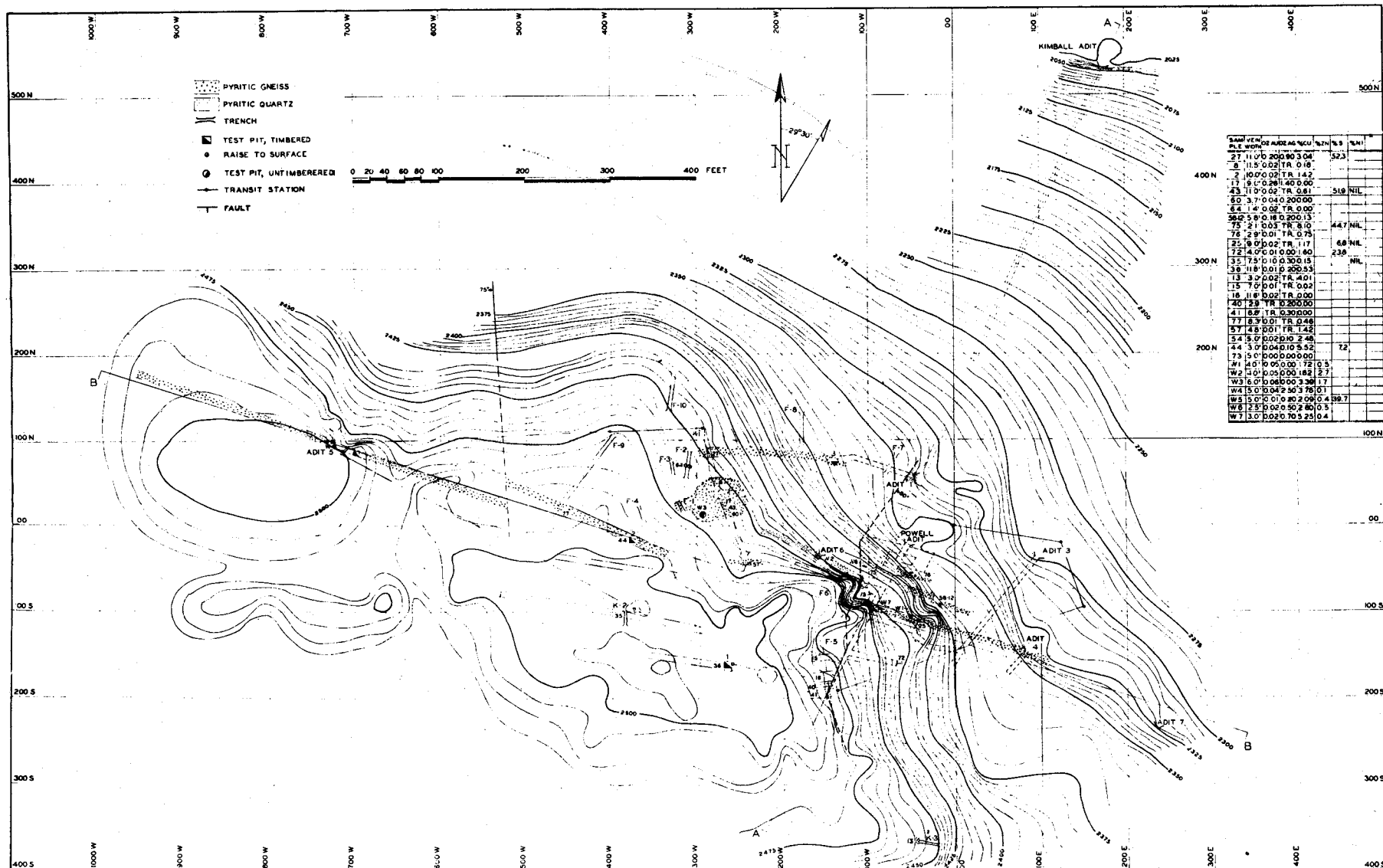


FIG. 3. - SURFACE AND UNDERGROUND DEVELOPMENT AT THE KHAYYAM MINE



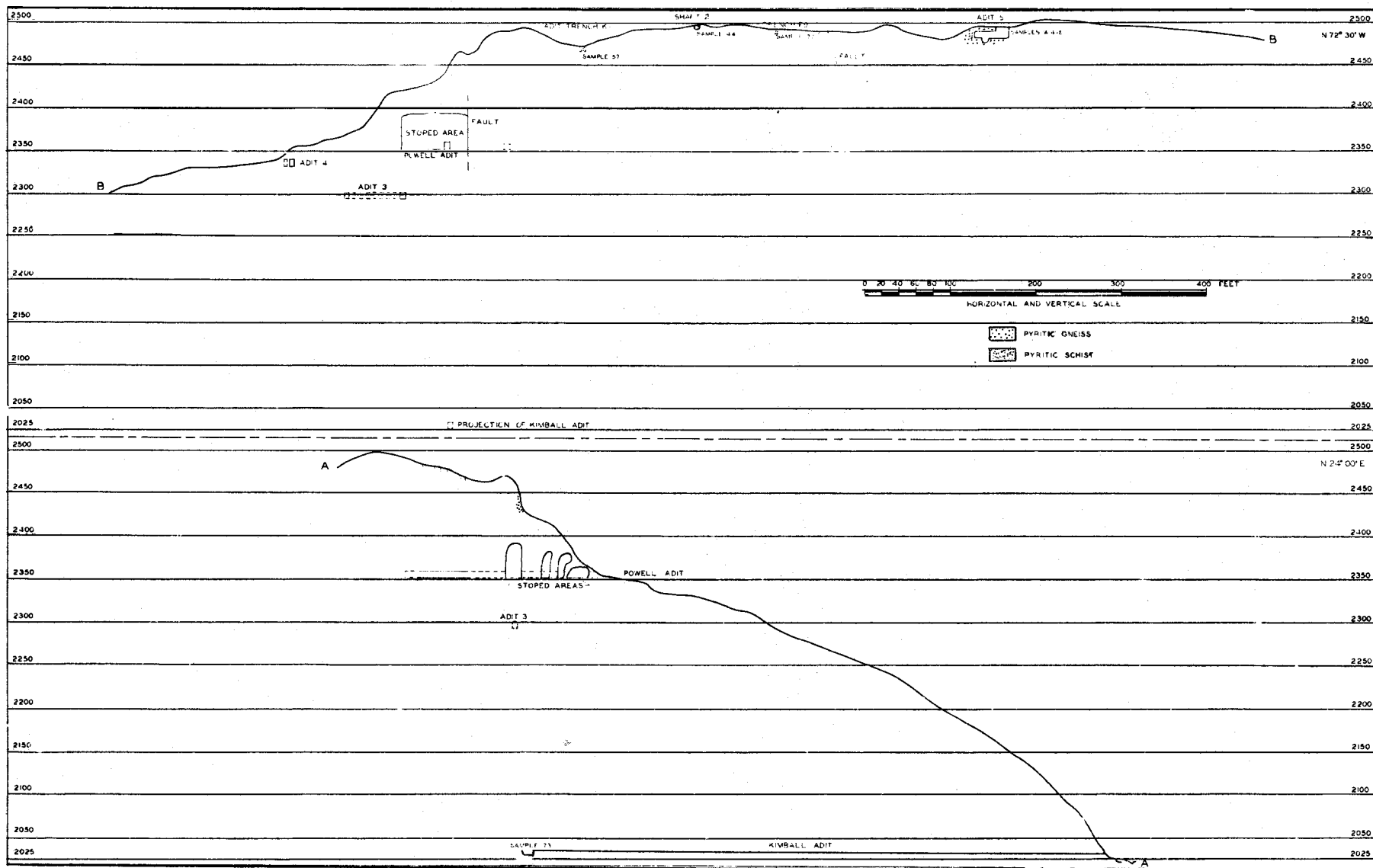


FIG. 4. - SECTIONS A-A AND B-B KHAYYAM MINE

## MINE DEVELOPMENT

Khayyam Mine

The main mine workings are entered through the Powell adit at an altitude of 2,350 feet. This adit, driven 198 feet with a bearing of S. 29° W., thence 38 feet to the face with a bearing of S. 17° E., crosscuts an ore zone of alternating hornblende gneiss and elongated sulfide lenses that have a width of 143 feet. Four lenses have been stoped to within a few feet of the surface. (See fig. 4.) The average trend of the ore bodies is N. 76° W. The dip appears to be nearly vertical, but the following dips were noted near the roof of three stopes numbered consecutively from the portal: No. 1, right side of adit, 58° SW.; No. 2, left side of adit, 68° SW.; and No. 3, left side of adit, 48° SW.

In stopes 2, 3, and 4, at 45, 100, and 135 feet, respectively, from the portal, the western limit of the ore is defined by a vertical fault that strikes N. 20° E. A vertical fault occurs on the right wall 138 feet from the portal, crosses the adit, and forms the left wall at the face. It is believed that this latter fault is a continuation of the one that marks the ore limit as described above.

Adit 1 is 80 feet north of the Powell adit at an altitude of 2,332 feet. It was driven in barren gneiss 75 feet on a bearing N. 71° W., and thence 16 feet on a bearing S. 81° W. to the face. A massive sulfide vein between the portal and 7 feet inside the adit appeared to be cut off by a fault striking N. 36° E. and dipping 80° E. It is believed that this fault is the northeastern continuation of the fault observed in the Powell adit. Slightly pyritized gneiss was observed beyond this fault for a distance of 43 feet along the adit.

One hundred fifty-two feet southeast of the Powell adit, and at an altitude of 2,292 feet, adit 3 was driven 139 feet to the face in barren gneiss. Some gossan was seen at the portal, and the gneiss is slightly pyritized for a distance of 89 feet inside the adit.

Starting at a point 187 feet southeast of the Powell adit, at an altitude of 2,329 feet, adit 4 was driven S. 42° W. about 45 feet in barren gneiss. The adit was started in a 12-foot-wide massive-sulfide vein. A band of gneiss averaging 3 feet in width is included in this width.

Adit 5 was driven 15 feet on a bearing S. 8° E. and thence 35 feet on a bearing S. 68° E., all in massive sulfide material. Eight feet from the face, a winze had been sunk to a depth of 5 feet, all in massive sulfide ore. This adit is 680 feet northwest of the Powell adit at 2,485 feet elevation.

Adit 6 was driven 5 feet into a mineralized ridge that strikes N. 72° W. This small cut reveals a 2-foot massive sulfide vein. This adit is 104 feet west of the Powell adit at an altitude of 2,420 feet.

Another short adit, No. 7, 359 feet southeast of the Powell adit and at an altitude of 2,314 feet, was driven a length of 26 feet at a bearing of S. 21° W. Very sparse pyritization in the gneiss was observed along the walls.

Years ago three test pits were sunk on the property, as follows: Test pit 1, two-compartment, in pyritized quartz vein, 12 feet deep, 250 feet southwest of the Powell adit and at a collar elevation of 2,503 feet. Test pit 2, single-compartment, 5 feet deep, in pyritic gneiss, 322 feet west of the Powell adit, and at a collar elevation of 2,497 feet. Test pit 3, single-compartment, 10 feet deep, in massive sulfide materials, situated 128 feet northwest of the Powell adit, and at a collar elevation of 2,368 feet.

One test pit 5 feet deep was sunk at the time of former operations in the massive sulfide zone cut by trench K-1. This trench is 165 feet in length and trends northward, crosscutting three lenses of massive sulfide ore.

The Kimball adit, 671 feet long and bearing S. 24° 30' W., is 600 feet northeast of the Powell adit and at an altitude of 2,025 feet and undercuts the Powell. (See fig. 3.) It was started in barren gneiss, but the 271 feet nearest the face is very slightly pyritized. Several slippage planes were observed, along which very slight movement had occurred.

#### Stumble-On

The main mine development at the Stumble-On consists of two adits at 1,100 and 1,250 feet, respectively. The lower one was driven S. 73° E. for 153 feet and thence S. 79° E. for 44 feet to the face. At a point 73 feet from the portal, a crosscut to the right, 12.5 feet in length, penetrated the mineralized zone and exposed barren gneiss at the face. At a point 132 feet from the portal, a crosscut 8 feet long was driven to the left in mineralized ground. A vein of massive sulfide material 18 inches wide appears in the roof of the adit at this point. One hundred seventy-four feet from the portal a 7- by 7-foot raise 21 feet high was driven in gneiss. The roof of the adit at this point was all mineralized. A vein of massive sulfide material 12 inches wide is exposed adjacent to the hanging wall in the face; the rest of the face is sparsely mineralized.

The Discovery adit, at an altitude of 1,250 feet, is driven S. 87° E. for 22 feet, thence S. 80° E. for 54 feet. It intersects a crosscut adit 44 feet long and bearing N. 3° E. Twenty-two feet of the crosscut adit lies in disseminated material between Discovery adit and the crosscut portal. Ten feet of crosscut south of Discovery adit is in disseminated sulfide material, the remainder being in barren gneiss to the face. (See fig. 5.) From the intersection of Discovery adit and the crosscut adit, the Discovery has a bearing S. 75° E. for 63 feet and thence a bearing S. 77° E. for 55 feet to the face. An 8-foot crosscut to the left of the adit, 175 feet from the portal, exposes heavily disseminated sulfide material. The face of the adit is fairly well mineralized, a 12-inch vein of massive sulfide material being exposed at the left of the face.

A crosscut adit was driven in the mineralized zone from the surface 151 feet east of the portal of the Discovery adit. The crosscut extends 16 feet into the enriched zone and thence 28 feet along the strike exposing a 10-foot width of massive sulfide ore.

Numerous short trenches also were excavated along the strike of the vein.

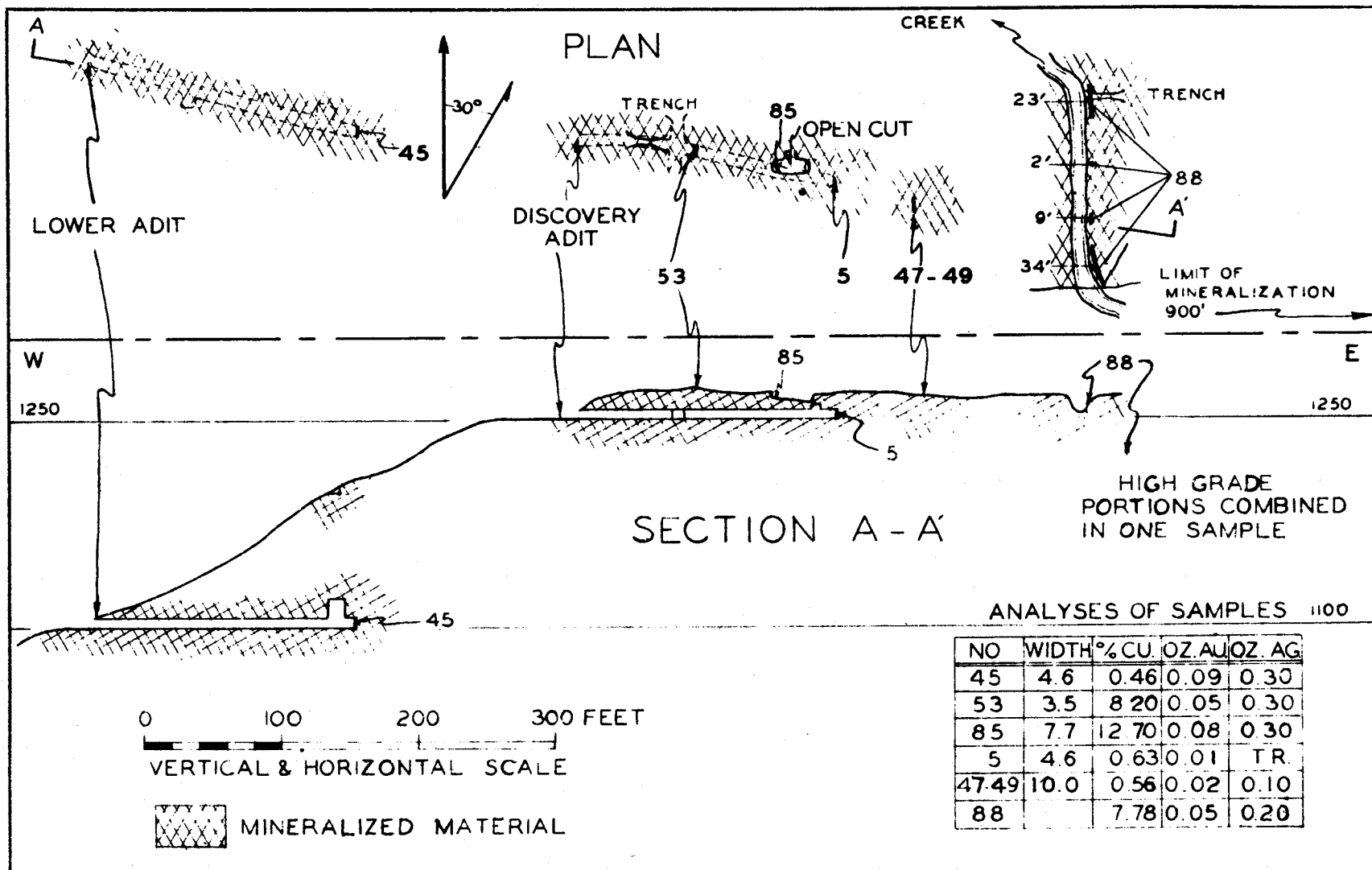


FIG. 5.-STUMBLE-ON CLAIM PRINCE OF WALES ISLAND SE. ALASKA

## SAMPLING AND ANALYSES

Khayyam Mine

Thirty-one channel samples were taken, which were analyzed for gold, silver, and copper. Samples W-1 to W-7, inclusive, were analyzed for zinc, seven representative samples were analyzed for sulfur, and three samples, representing the pyrrhotite-enriched ore body, were analyzed for nickel. The analyses showed no nickel in these samples. (See fig. 3.)

Two distinct phases of mineralization are prevalent at the Khayyam mine, which for field determination and simplicity in mapping are referred to as pyritic gneiss and pyritic quartz. In the "pyritic-gneiss" phase of enrichment, the sulfide minerals range from massive, some 5 to 50 feet wide, to disseminated pyritization of the country rock. In the "pyritic-quartz" phase of enrichment, the sulfide minerals are disseminated sparsely in a quartz gangue. Extensive sampling of this latter did not seem to be justified, which was substantiated by the analyses of the six samples that were cut.

Two samples were cut on the floor of the Powell adit in stopes 2 right and 3 right. These samples - No. 75, 20 feet off the center line of the adit, and No. 54, 25 feet off the center line - were cut across the ore body.

The samples were analyzed by the Territorial Assay Office in Ketchikan, Alaska.

Stumble-On

Six heavy chip samples averaging 1 by 6 inches in cross section were cut, two of which were underground samples in the face of the two adits; the other four were surface samples. These samples were analyzed for copper, gold, and silver. For results of the analyses see figure 5.

Sample 88 is a composite sample taken along a creek 370 feet east of the portal of the Discovery adit. The creek traverses the mineralized zone about normal to the strike. A width of 149 feet of mineralized material was logged, as follows:

- 0 to 34 feet, altered gneiss heavily disseminated with sulfide minerals.
- 34 to 48 feet, altered gneiss sparsely disseminated with sulfide minerals.
- 48 to 51 feet, massive sulfide vein.
- 51 to 57 feet, altered gneiss heavily disseminated with sulfide minerals.
- 57 to 93 feet, altered gneiss sparsely disseminated with sulfide minerals.
- 93 to 95 feet, altered gneiss heavily disseminated with sulfide minerals.
- 95 to 126 feet, altered gneiss sparsely disseminated with sulfide minerals.
- 126 to 149 feet, altered gneiss moderately disseminated with sulfide minerals, and veinlets of massive sulfide minerals.

Sample 88 represents the following lengths: 0 to 34 feet, 48 to 57 feet, 93 to 95 feet, and 126 to 149 feet. Mineralization of each sample is uniform throughout.

## WORK DONE BY THE BUREAU OF MINES

Two temporary tent camps were established, one at tidewater and the other at an altitude of 2,000 feet, approximately three-fourths mile from the Khayyan mine. A trail  $4\frac{1}{2}$  miles long was brushed out to the upper camp. All equipment and supplies were flown from the beach to a site near the mine. As cargo parachutes were unobtainable, it was necessary to pack carefully all canned goods and other breakable items. These were made up into bundles of 50 pounds. Two hundred fifty square feet of 1- by 8-inch shiplap in 4-foot lengths, for tent flooring, was dropped without trouble or damage. However, 60 gallons of stove oil in five 15-gallon drums was a total loss, even though the drums were dropped from 75 feet and landed in deep snow. There was, roughly, 20-percent loss of provisions.

Eleven trenches totaling 611 feet were excavated to an average width of 2.5 feet and an average depth of 3 feet. One hundred yards of alluvium and 69.8 yards of loose rock were moved.

A transit control traverse covering 3.15 acres was completed as a basis for a detailed surface topographic and geologic survey.

Thirty-one channel samples were cut with moil and hammer, the average cross section of the channels being 2 by 6 inches. The samples were crushed in a mortar with a 4-pound hammer and quartered.

The work done by the Bureau on the Stumble-On claim consisted of a Brunton and tape surface survey about 1,600 feet in length, underground surveying of the two adits, 197 feet and 194 feet long, and cutting six heavy chip samples. The samples were cut with moil and hammer, crushed in a mortar, and quartered. The average cross section was 1 by 6 inches. No trenching was done, though a small amount of material was excavated in cleaning the old surface cuts prior to cutting the samples.

No camp was established for the examination because of the proximity of this property to the temporary camp constructed by the Bureau of Mines for formally examining the Khayyan mine  $1\frac{1}{2}$  miles to the west.