UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

BUREAU OF MINES
R. R. Sayers, Director

War Minerals Report 227

POOR MAN IRON DEPOSIT
KASAAN PENINSULA, PRINCE OF WALES ISLAND
SOUTHEASTERN ALASKA

WASHINGTON: 1944

WAR MINERALS REPORT
UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

W.M.R. 227 — Iron August 1944

POOR MAN IRON DEPOSIT
Kasaan Peninsula, Prince of Wales Island
Southeastern Alaska

SUMMARY

Surface sampling and core drilling at the Poor Man iron deposit near tidewater on the north shore of Kasaan Bay, Prince of Wales Island, Southeastern Alaska, were completed by the Bureau of Mines in June 1943.

Exploration disclosed 990,900 long tons of measured ore containing 52.40 percent iron, 0.25 percent copper, 3.72 percent sulfur, and 0.03 percent phosphorus, and in addition approximately 180,300 long tons of indicated and 223,400 long tons of inferred ore of probably the same analysis.

Beneficiation tests by the Bureau indicate that the ore is amenable to concentration by flotation and magnetic separation for the purpose of increasing the iron content, reducing sulfur, and recovering a salable copper concentrate. Ore may be concentrated at the mine or at the smelter, which would probably be in the Puget Sound area. The latter course is considered preferable.

The cost of a complete mine plant, with road to beach, dock, ore bunker with loading facilities, and camp is estimated at $224,000 and concentrating and sintering plant at $600,000, a total of $824,000. Including an operating fund, the total capital required will be $974,000. Mine and mill could be ready for production within 6 months after starting operations.

INTRODUCTION

The Poor Man iron deposit on Kasaan Peninsula, Prince of Wales Island, Southeastern Alaska, was examined in August 1942 by an engineer[1] of the Bureau of Mines and John C. Reed and E. N. Goddard, geologists of the Federal Geological Survey. In September 1942, the area was mapped geologically, and a magnetic survey was made by the Geological Survey.[2]

1 Robert L. Thorne.

2 Warner, L. A., Poor Man Iron Prospect, Kasaan Peninsula, Southeastern Alaska: Geological Survey, unpublished report.

Walton, Matt, A Magnetic Survey of Magnetite Ore Bodies, Kasaan Peninsula, Southeastern Alaska: Paper presented before the Geological Society, Washington, D. C., 1942.

In October and November 1942, a second preliminary examination, which included cleaning out and sampling old adits and trenches, was made by Bureau engineers.[3] J. G. Shepherd, consultant of the Bureau, spent two weeks in March and April 1943 investigating the Poor Man iron and other deposits on Kasaan Peninsula. Core drilling was completed by Bureau engineers[4] in June 1943.

L. A. Warner, of the Geological Survey, examined all cores and interpreted structural data revealed by the drilling.

A number of iron and copper deposits on Prince of Wales Island are being investigated by the Bureau. This report deals specifically with the Poor Man deposit, where exploration has been sufficient to permit the preparation of estimates on reserves and mining and milling costs.

LOCATION AND ACCESSIBILITY

The deposit is located at latitude 55° 33' north, longitude 132° 26' west on the north side of Kasaan Bay on Prince of Wales Island, Southeastern Alaska. It is 2 miles northwest of the village of Kasaan by Forest Service trail and 35 miles northwest by water from Ketchikan. The general location is shown in figure 1.

Kasaan has one store, a post office, an elementary school, and a cannery. Except when the cannery is operating during the salmon-fishing season in July and August, the community consists of less than 50 persons, mostly native Indians.

Ketchikan, a city of about 6,000 people, is a seaport on the inside-passage waterway, 750 miles north of Seattle, and has regular steamer service at frequent intervals supplied by the Alaska Steamship Co., Northland Transportation Co., Canadian Pacific Railway Co., Steamship Service, and Canadian National Lines.

Ocean freight rate, as quoted by steamship companies on ore or concentrate from Poor Man to points on Puget Sound, is $4.50 a ton plus longshoring charges for loading and unloading. This rate, of course, is out of reason for iron ore in shipload lots. It is reported that marble and limestone were shipped from Dall Island to Seattle for 90 cents a ton, in barges, and that copper ore and concentrate were shipped from Salt Chuck to Tacoma in small motor ships for $1.50 a ton. It is believed that a rate of $1.50 a ton, or perhaps less, can be obtained for shipload lots. The figure of $1.50 a ton is used for the purpose of estimates in this report.

Ketchikan is the best available source for food, mining supplies, and labor. From Ketchikan, regular weekly trips are made to Kasaan by the motor ship Eureka, which carries mail, passengers, and freight. During the fishing season, there is regular radiophone service from Kasaan to outside points via Ketchikan.

[3] Stephen P. Holt, Robert L. Thorne, and Aner W. Erickson.
[4] Stephen P. Holt and A. W. Tolonen.

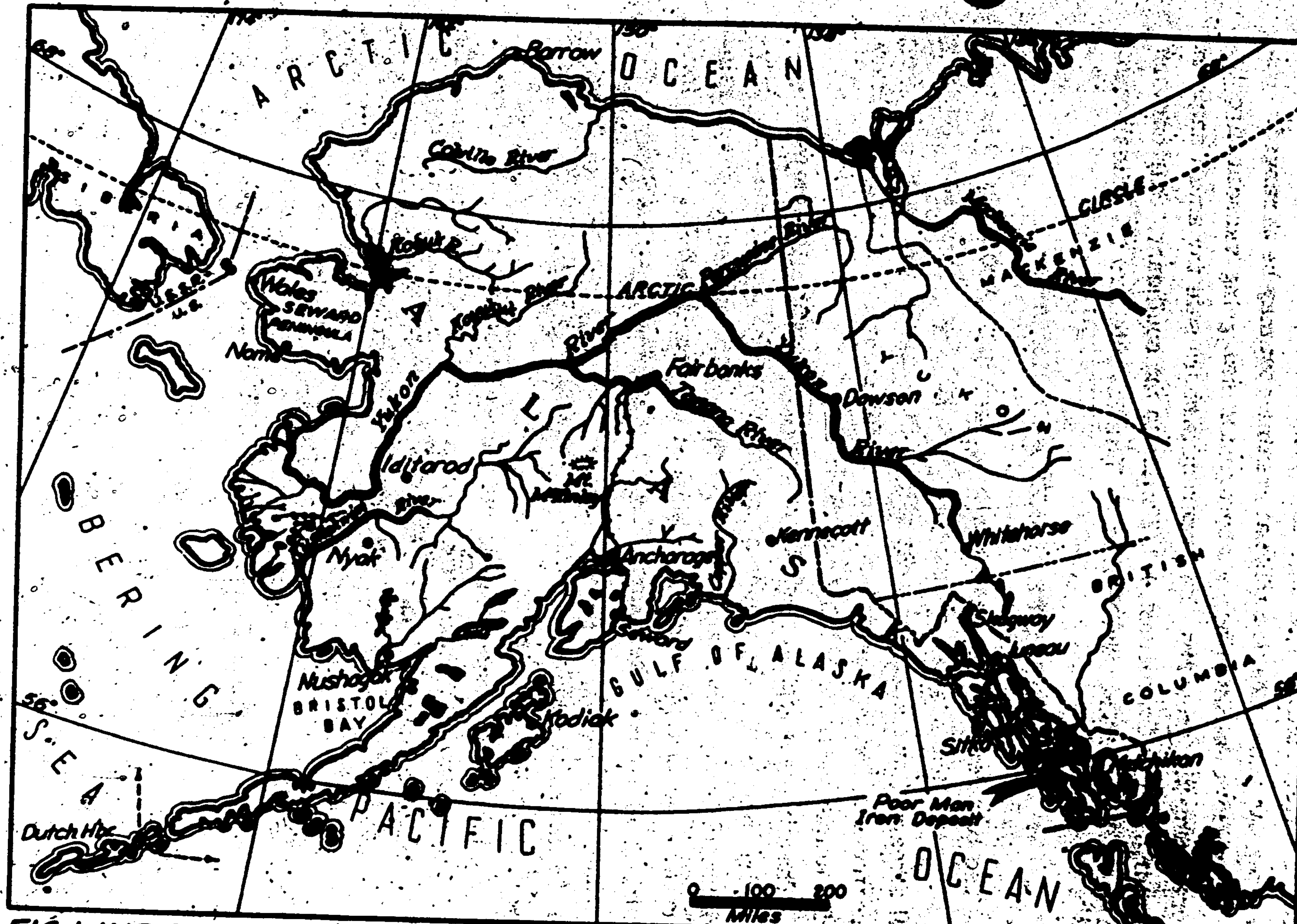


FIG. 1-INDEX MAP, SHOWING LOCATION OF POOR MAN IRON PROSPECT

There are no roads on Kasaan Peninsula. A Forest Service trail from Kasaan to Salt Chuck passes the south end of the Poor Man property.

Airplane service from Ketchikan to Kasaan or from Kasaan to Ketchikan, if previously arranged, is available on regular trips by small seaplanes of the Ellis Airways from Ketchikan to points on the west coast of Prince of Wales Island. The fare is $10 a passenger if set off or picked up on a regular trip. Charter trips at greater cost may be arranged.

There is a fair-weather anchorage for sea-going vessels directly offshore from the property. The nearest harbors safe for small ships in heavy storms are at Long Island, 4-1/2 miles to the southeast. Safe harbors for larger vessels are at Coal Harbor or Twelve-Mile Arm, 4 miles southwest.

PHYSICAL FEATURES AND CLIMATE

The ore deposit lies on a heavily wooded flat 1,500 to 3,000 feet inland from the beach at an altitude of 50 to 200 feet. Poor Man Creek, a small stream, flows along the west side of the deposit, with a branch from the northeast. During the driest part of the summer of 1943, this creek carried ample water for mining and camp use.

The climate is typical of southeastern Alaska, with mild temperatures, rarely dropping to 0° F. in winter or rising above 90° F. in summer. Precipitation is heavy, approaching the average of 159 inches a year of rainfall reported at nearby Ketchikan. Most of the precipitation is in the form of rain, snowfall not often amounting to more than 4 to 6 inches a year. The winter of 1942-43 was said to be unusual, with 8 inches of snow at sea level, 24 inches at 400 feet elevation in December, and temperatures at or below 0° F. for 10-day periods.

Mining operations can be conducted here throughout the year if proper housing is provided. Shipping to and from Seattle continues throughout the year by vessels moving along the ice-free inside passage.

Vegetation is luxuriant, with dense undergrowth near sea level and fine stands of spruce and hemlock and some yellow cedar - ample timber for any reasonable mining use or camp construction.

LABOR AND LIVING CONDITIONS

Under peacetime conditions, labor is reported to have been plentiful and wages reasonable in this area. At present (January 1944), skilled labor is scarce and all wages are high. The hourly wage being paid for common labor is $0.965 an hour; mechanics, miners, and carpenters receive $1.20 to $1.50 an hour for 40 hours weekly and time and a half for work over 40 hours. Kasaan is a nearby source of labor and can furnish a limited number of native workers, some of whom are skilled carpenters and mechanics, to work except during the fishing season. When available, this native labor has been found to be generally satisfactory.

Because of the mild climate, living conditions are good, although the excessive rainfall is trying for men working outdoors if they are not accustomed to it. As there are no buildings (except two small occupied cabins) on the property and no nearby housing is available, camps would have to be built to house all workmen engaged in any contemplated exploitation of the deposit.

HISTORY AND PRODUCTION

James Coleman, one of the owners, reports that the property was first located in 1903 by Jack Kirman. Kirman relinquished his title to Billy Anderson, who turned the property over to Coleman. During the early 1900's, a stock company trying to develop a copper mine did considerable work, including the driving of three short adits and the sinking of three shallow shafts. A surface tramway from the beach to the deposit and a small dock were built. This enterprise failed when it became apparent that the grade of the copper would not support the operation. No iron ore has been shipped except one small lot for testing, results of which are not available.

PROPERTY AND OWNERSHIP

The property consists of three unpatented claims registered with the United States Commissioner at Ketchikan, Alaska. Of these, Iron King No. 1 covers a small, isolated copper deposit; Iron King No. 2 covers the beach, Coleman's residence, and the trail north to the iron deposit; and Iron King No. 3 covers the iron outcrops.

The joint owners of the property are James Coleman, who lives on it, Erick Lindeman, Ketchikan, Alaska, and A. L. Howard, 7514 Brooklyn Avenue, Seattle, Wash.

ORE DEPOSIT

The Poor Man iron deposit has been traced for a distance of 1,500 feet along the strike and for a maximum surface width of 150 feet. It is of the contact-metamorphic type, the principal ore minerals being magnetite, chalcopyrite, and pyrite in a gangue of epidote, garnet, hornblende, quartz, and calcite. Country rock is the Kasaan greenstone, a dense gray and greenish rock, possibly of volcanic source, now highly metamorphosed, silicified, and epidotized, expecially near the ore body. There are included lenses of limestone metamorphosed to coarsely crystalline gray and white marble.

The ore occurs in a breccia zone in the greenstone. No clearly defined bedding planes were seen, either in the ore or the country rock, though many small seams, roughly parallel to the ore contacts, were observed. The eastern or footwall contact of the ore, as determined by core drilling, dips 50° to 70°, averaging 60°, westerly. The western or hanging wall is steeper and more irregular, dipping generally from 70° westerly to 90° and averaging 80°. Strike of the ore body is approximately north-south.

The south end of the ore body is covered by alluvium. Dip-needle surveys by the Bureau of Mines and the Geological Survey indicate that the ore continues 50 to 100 feet farther south and there pinches out or pitches steeply downward. The former condition appears more probable. At the north end, no ore is seen at the surface as far north as No. 4 shaft, which is down 10 feet in alluvium and glacial till. Dip-needle surveys indicate that ore continues 10 to 15 feet farther north, where it is cut off abruptly, possibly by a concealed fault striking easterly against a wall of gray and white marbleized limestone. No abnormal dip-needle readings were observed beyond this point.

Several dikes of syenite occur within the ore at the surface; these are shown in the accompanying figure 2. Dikes of syenite, andesite, and diabase also were intersected by drill holes. Estimates based upon the results of drilling indicate that waste included in the ore body amounts to 4.49 percent of the whole by volume or 3.09 percent of the whole by weight.

Chalcopyrite and pyrite occur, apparently in larger amounts, at and near the margins of the ore body, although they also occur scattered irregularly throughout the ore. Chalcopyrite is found mostly along cracks and seams; pyrite is disseminated mostly through the magnetite. Results of the Bureau's sampling indicate that the total sulfides included in the iron ore amount to 7.0 percent.

SAMPLING AND ASSAYING

During October and November 1942, the Bureau of Mines cleared out 14 old trenches and took 103 channel samples and 13 chip samples from them and the walls of the 3 adits. The chip samples were taken only in ore apparently uniform in grade. Location of these samples is shown in figure 2, and results of analyses in figure 2-A.

Between April and June 1943, the Bureau of Mines drilled 13 diamond-drill holes ranging from 25 to 203 feet in depth. The total length of hole drilled on the deposit was 1,549.7 feet. Locations of these holes are shown in figure 2, and sections on line of holes, with analyses of samples, are shown in figures 3 to 9, inclusive.

Sludge from core drilling was carefully collected, dried, and split. Sludge was analyzed by the Territorial assay office, Ketchikan, Alaska. Cores were split and analyzed by a private concern in the States.

Sludge and core analyses were adjusted by the Longyear method. Both individual and average analyses for iron, shown in figures 3 to 9, are adjusted from individual core and sludge analyses. The copper analyses are adjusted likewise, but the average analyses for other metals are derived from composites of core samples only.

Adjusted and weighted average of all samples indicate that the ore content is as follows:

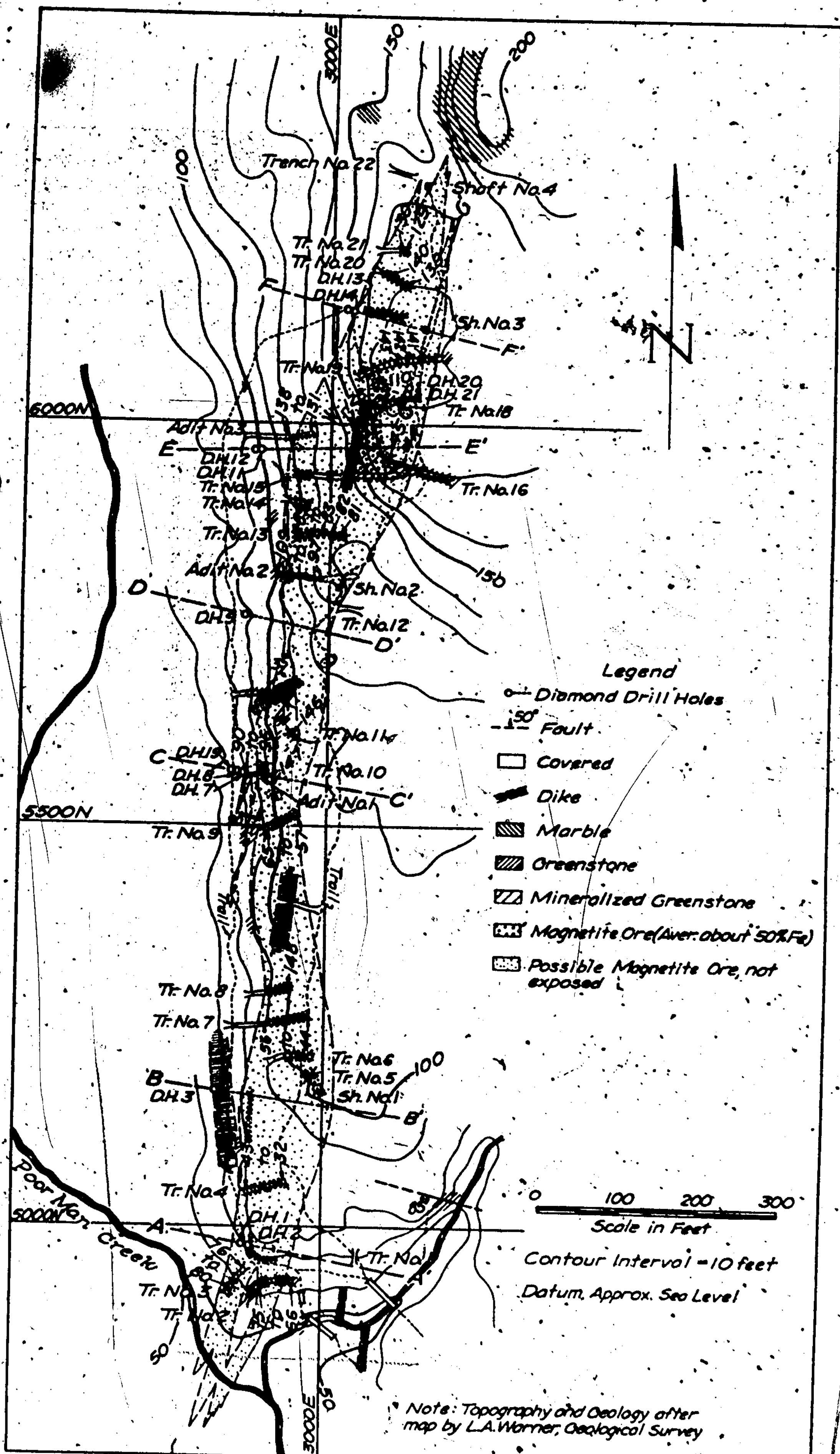


FIG. 2, POOR MAN IRON DEPOSIT, KASAAN, ALASKA

TRENCH NO. 4

Sample No.	%Cu	%Fe
32	Nil	58.40
33	Nil	60.20
34	Nil	58.80
35	Nil	60.50
36	0.05	60.10
37	Nil	61.20
38	Tr.	61.00
39	Nil	61.60
40	Nil	52.60
41	Tr.	61.00
42	Nil	57.80
43	Nil	49.40

TRENCH NO. 7

Sample No.	%Cu	%Fe	Composits
44	Tr.	52.7	Au-0.03 oz/ton
45	0.09	54.8	Ag-0.05 oz/ton
46	0.10	57.3	Insol.-12.59%
47	Tr.	57.3	S-1.16%
48	Nil	54.0	P-0.05%
49	Nil	60.9	Mn-0.05%
50	Nil	37.9	Ti-Trace
51	0.05	41.2	
52	0.10	12.0	
53	0.09	33.75	Au-0.01 oz/ton
54	0.05	27.25	Ag-Trace
55	Tr.	24.8	Insol-39.60%
56	Nil	16.7	

TRENCH NO. 9

Sample No.	%Cu	%Fe	Composits
57	Nil	60.5	Au-0.02 oz/ton
58	0.02	50.4	Ag-0.03 oz/ton
59	Tr.	50.3	Insol-9.86%
60	Tr.	43.5	S-1.53%
61	0.07	61.5	P-0.03%
62	0.04	50.5	Ti-0.06%
63	0.01	58.5	
64	0.01	55.6	
65	0.01	59.4	

TRENCH NO. 2

Sample No.	%Cu	%Fe	Composits
66	0.01	29.5	
67	0.03	38.6	
68	0.02	39.0	Au-0.04 oz/ton
69	0.17	38.0	Ag-0.10 oz/ton
70	0.45	22.88	Insol-13.00%
71	0.57	42.3	S-1.36%
72	0.32	56.2	P-0.06%
73	0.11	60.0	Ti-0.01%
74	0.03	29.9	
75	0.02	26.1	

TRENCH NO. 3

Sample No.	%Cu	%Fe
76	0.09	57.6
77	0.05	58.0
78	0.04	58.5
79	0.12	53.7
80	0.07	52.0

TRENCH NO. 13

Sample No.	%Cu	%Fe	
			Au-0.06 oz/ton
81	0.39	37.2	Ag-0.18 oz/ton
82	0.50	57.5	Insol-18.95%
83	0.15	49.4	Au-0.05 oz/ton
84	0.09	54.8	Ag-0.12 oz/ton
85	0.05	48.3	Insol-11.10%
86	0.22	45.7	S-0.97%
87	0.13	49.2	P-0.01%
88	0.49	42.1	Ti-Trace
89	0.11	47.8	

ADIT NO. 1

Sample No.	%Cu	%Fe	Composits
90	0.15	55.0	Au-0.02 oz/ton
91	0.39	38.5	Ag-0.05 oz/ton
92	0.34	34.8	Insol-9.52%
93	0.51	49.6	S-5.28%
94	1.00	37.8	P-0.03%
95	0.38	51.3	Ti-Trace
96	0.36	49.1	

ADIT NO. 2

Sample No.	%Cu	%Fe	Composits
97	0.51	53.0	Au-0.05 oz/ton
98	0.69	41.8	Ag-0.14 oz/ton
99	0.65	34.4	Insol-21.17%
100	0.51	31.2	S-6.49%
101	1.04	26.1	P-0.02%
102	1.70	36.8	Mn-0.02%
103	0.81	42.9	Ti-0.15%
104	0.61	44.[illegible]	
105	0.21	24.8	
106	0.35	24.8	
107	0.57	22.1	
108	0.89	21.7	
109	0.93	5.2	

TRENCH NO. 18

Sample No.	%Cu	%Fe	Composits
110	0.22	55.5	
111	0.12	60.1	
112	0.14	61.25	
113	0.19	58.6	
114	0.18	62.0	Au-0.02 oz/ton
115	0.28	59.35	Ag-0.04 oz/ton
116	0.35	56.5	Insol-7.94%
117	0.25	48.5	S-1.46%
118	0.52	51.5	P-0.02%
119	0.04	59.6	Mn-0.03%
120	0.17	62.75	Ti-0.10%
121	0.09	55.75	
122	0.09	15.78	
123	0.18	58.55	
124	0.11	57.95	Au-0.02 oz/ton
125	0.11	57.25	Ag-0.03 oz/ton
126	0.01	58.6	Insol-16.72%
127	0.05	51.4	
128	0.06	7.54	

TRENCH NO. 21

Sample No.	%Cu	%Fe
129	0.60	38.95
130	0.01	59.25

ADIT NO. 3

Sample No.	%Cu	%Fe	Composits
131	Nil	54.1	
132	0.03	59.2	Au-0.03 oz/ton
133	0.02	49.35	Ag-0.06 oz/ton
134	0.04	53.5	Insol-16.00%
135	0.08	49.35	S-1.35%
136	0.14	50.45	P-0.01%
137	0.04	41.95	Ti-Trace
138	0.02	35.5	

TRENCH NO. 20

Sample No.	%Cu	%Fe
139	Nil	55.2
140	Nil	49.4

TRENCH NO. 19

Sample No.	%Cu	%Fe
141	0.01	57.9
142	Tr.	55.0
143	0.01	56.4

TRENCH NO. 16

Sample No.	%Cu	%Fe
144	0.02	53.1
145	Nil	57.0

TRENCH NO. 11

Sample No.	%Cu	%Fe
146	1.14	35.2

TRENCH NO. 10

Sample No.	%Cu	%Fe
147	0.17	59.35

TRENCH NO. 8

Sample No.	%Cu	%Fe
148	0.04	56.0

FIG. 2A-ANALYSES, POOR MAN IRON DEPOSIT

Average Analysis for portion of Hole in Ore (Percent)

Hole No.	Fe	Cu
1	56.88	0.15
2	60.28	0.12

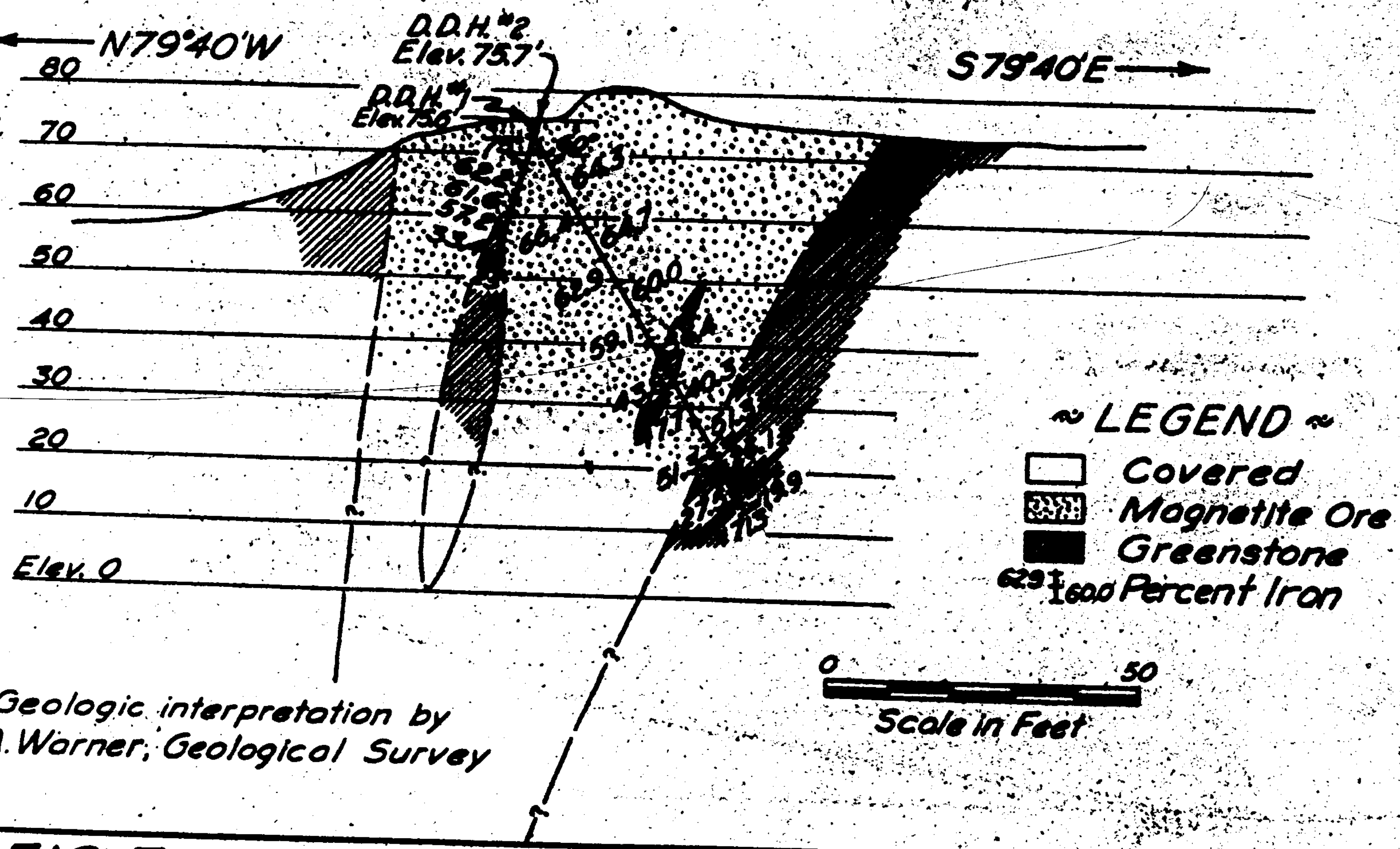
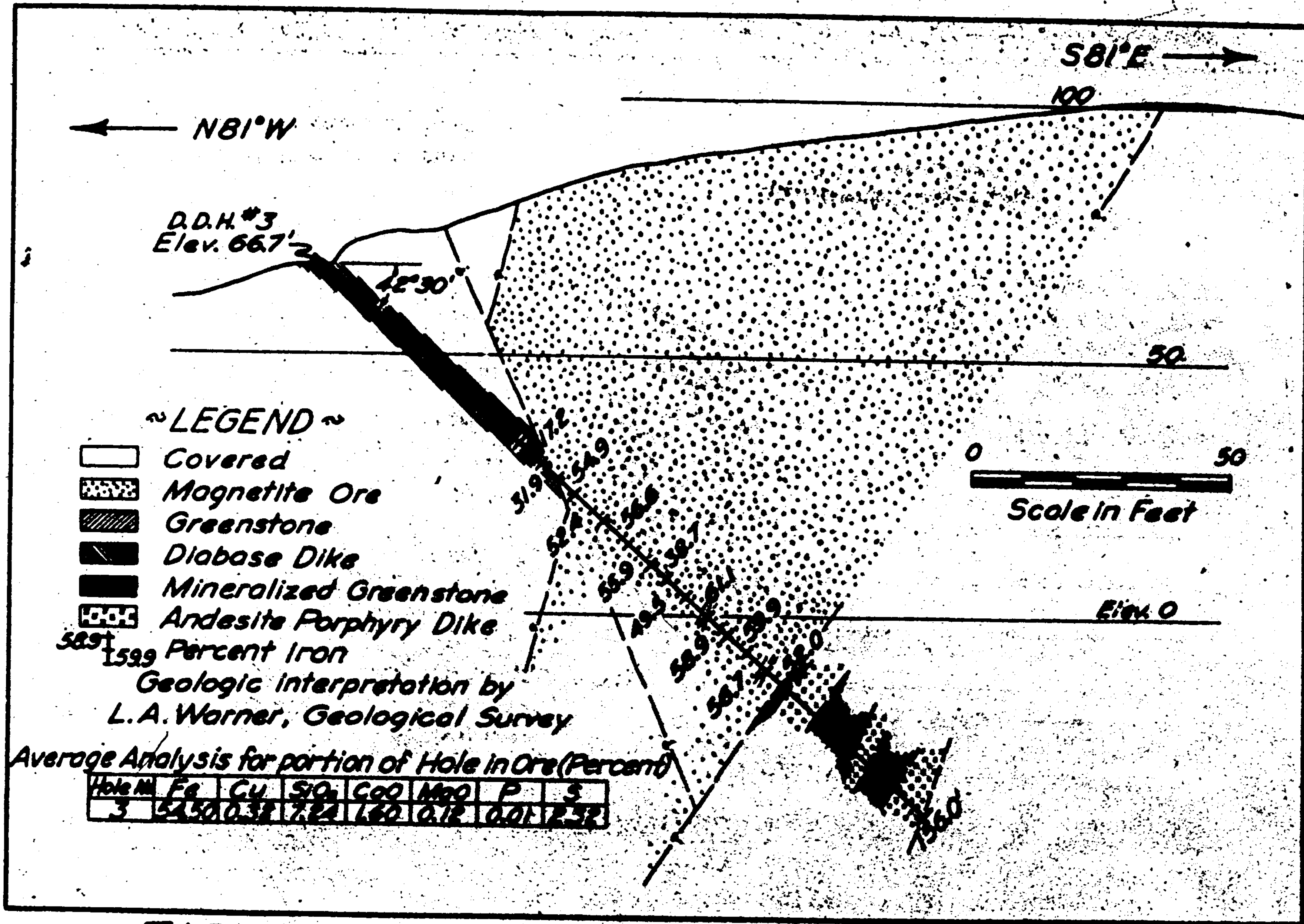
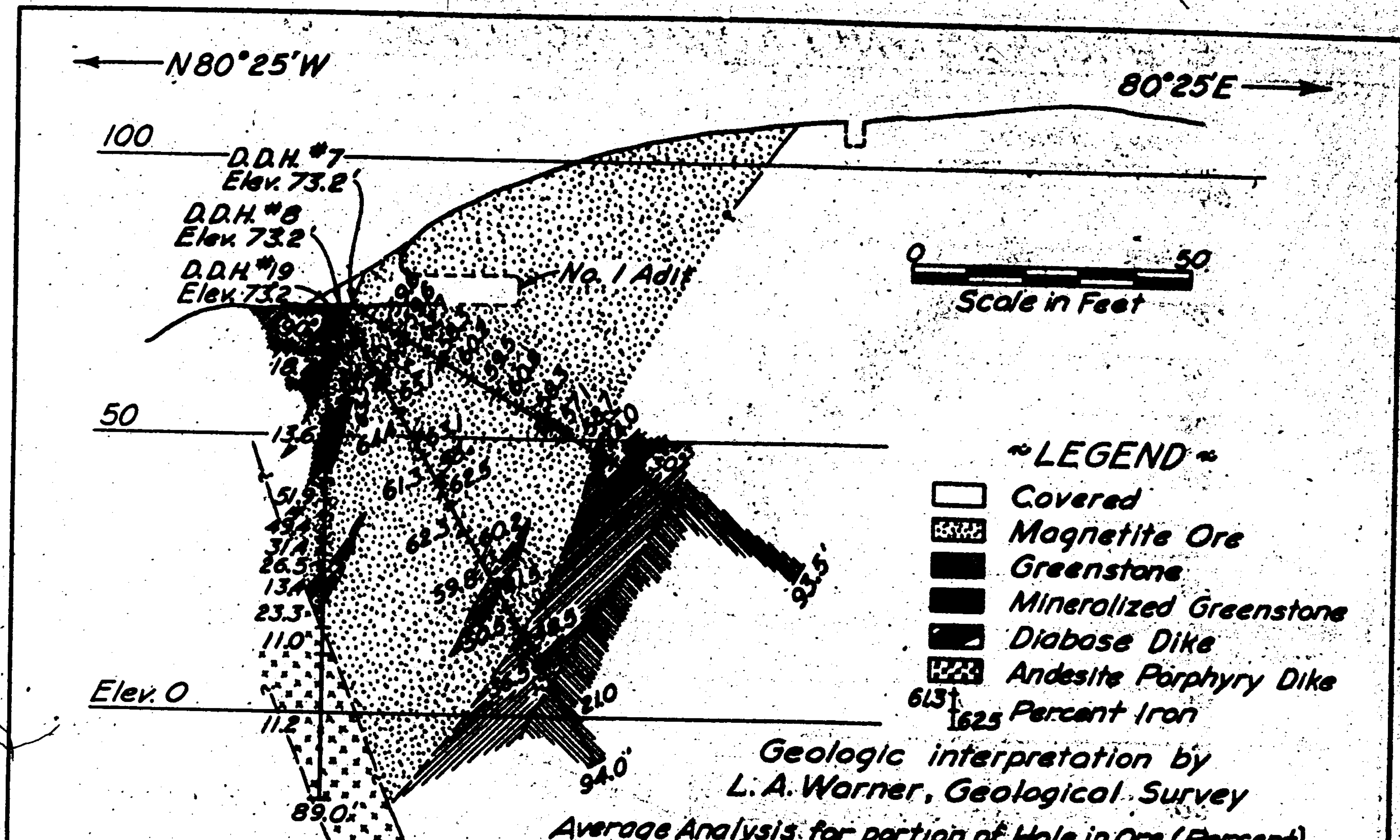


FIG. 3-SECTION A-A', ON LINE OF HOLES 1 AND 2



Hole No.	Fe	Cu	SiO_2	CaO	MgO	P	S
3	54.50	0.32	7.24	1.60	0.12	0.01	2.52

FIG. 4 – SECTION B-B' ON LINE OF HOLE 3



Average Analysis for portion of Hole in Ore (Percent)

Hole No.	Fe	Cu	SiO_2	CaO	MgO	P	S
7	58.00	0.51	4.96	2.84	0.18	0.01	2.88
8	59.24	0.58	7.50	2.46	0.10	0.01	3.50
19	43.9	0.64	—	—	—	—	—

FIG. 5.-SECTION C-C', ON LINE OF HOLES 7, 8, AND 19

Average Analysis for portion of Hole in Ore (Percent)

Hole No.	Fe	Cu	SiO_2	Al_2O_3	CaO	MgO	P	S
9	46.83	0.21	11.76	1.48	5.54	3.32	0.02	2.89

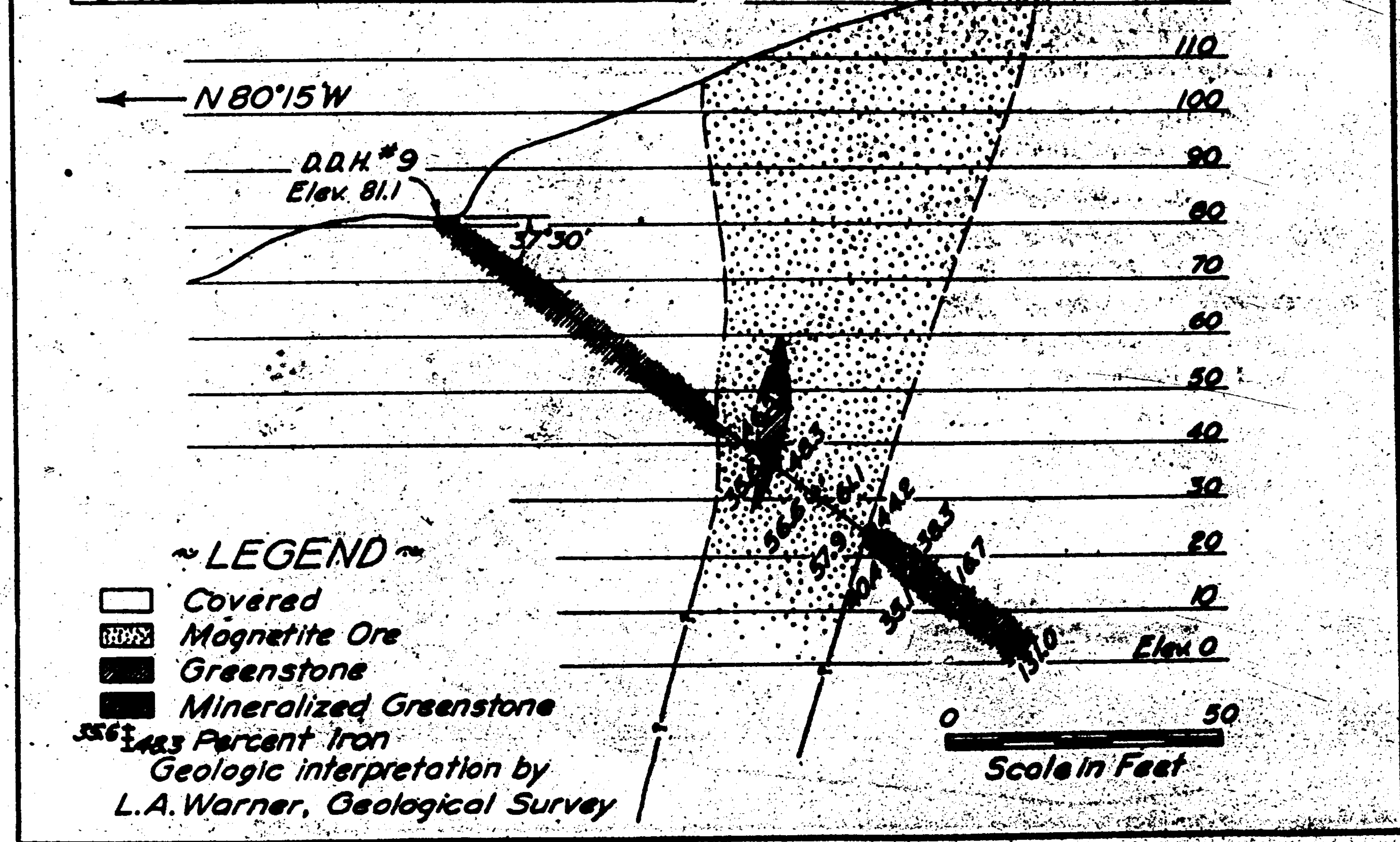
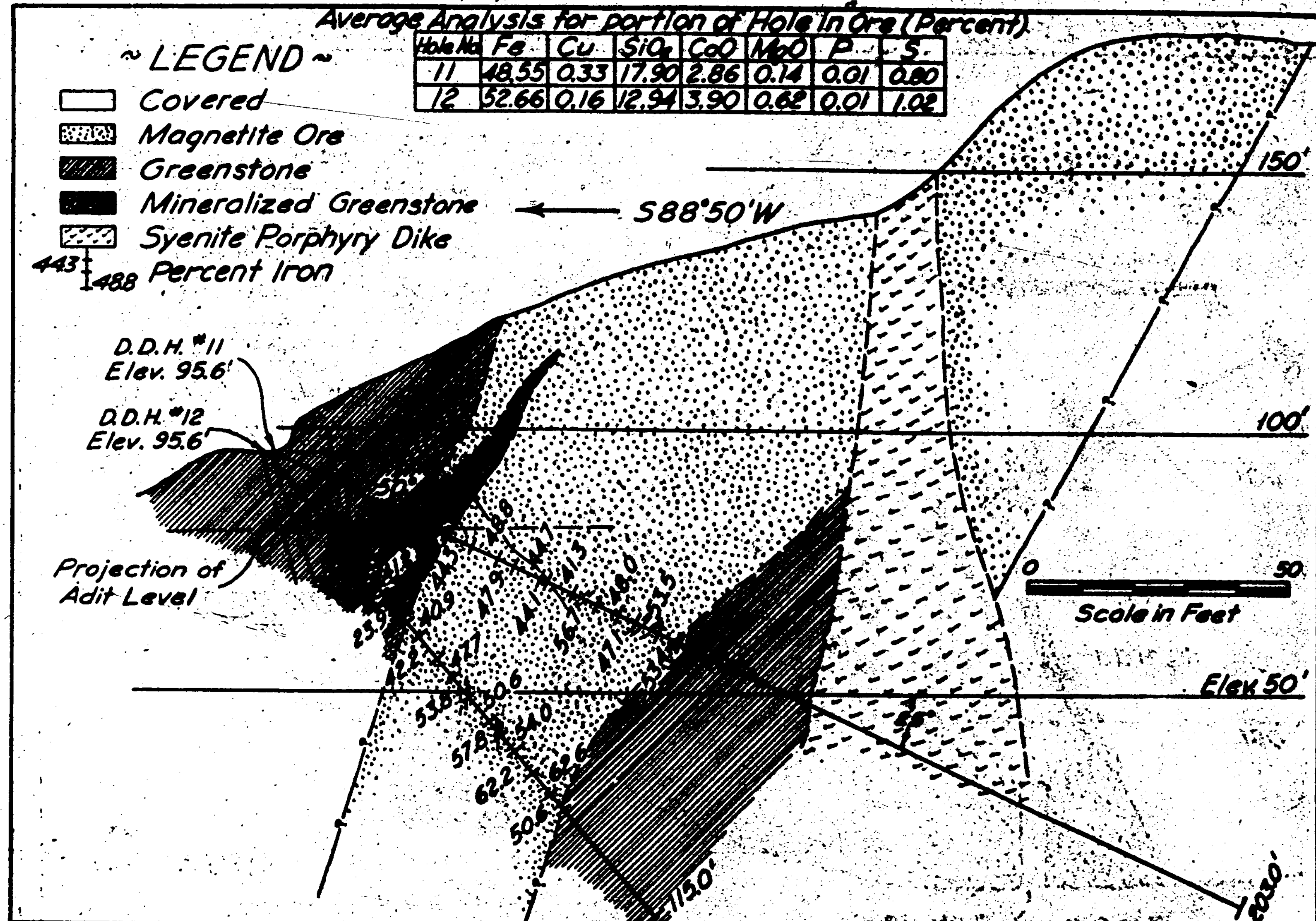


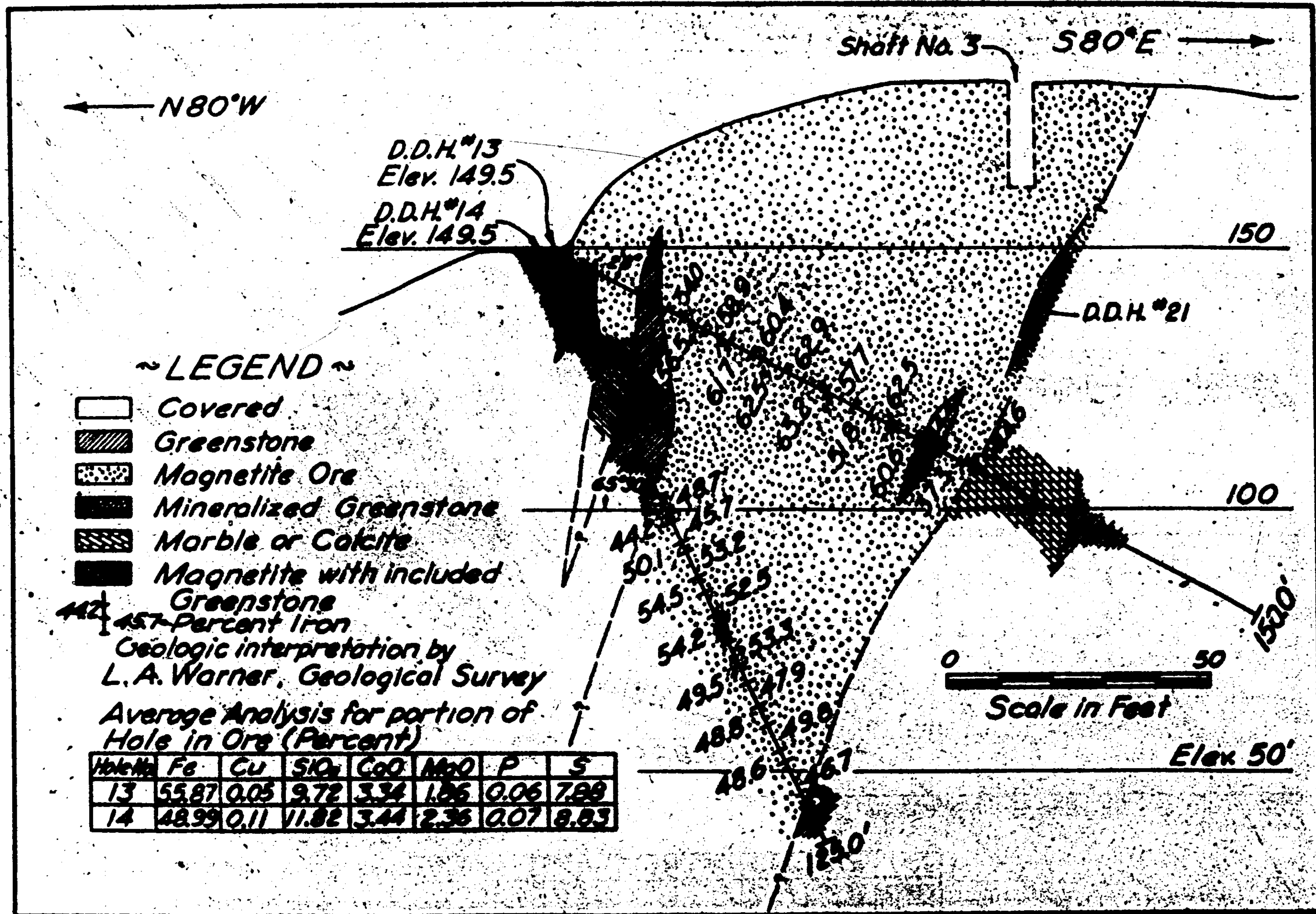
FIG. 6 - SECTION D-D' ON LINE OF HOLE 9



Average Analysis for portion of Hole in Ore (Percent)

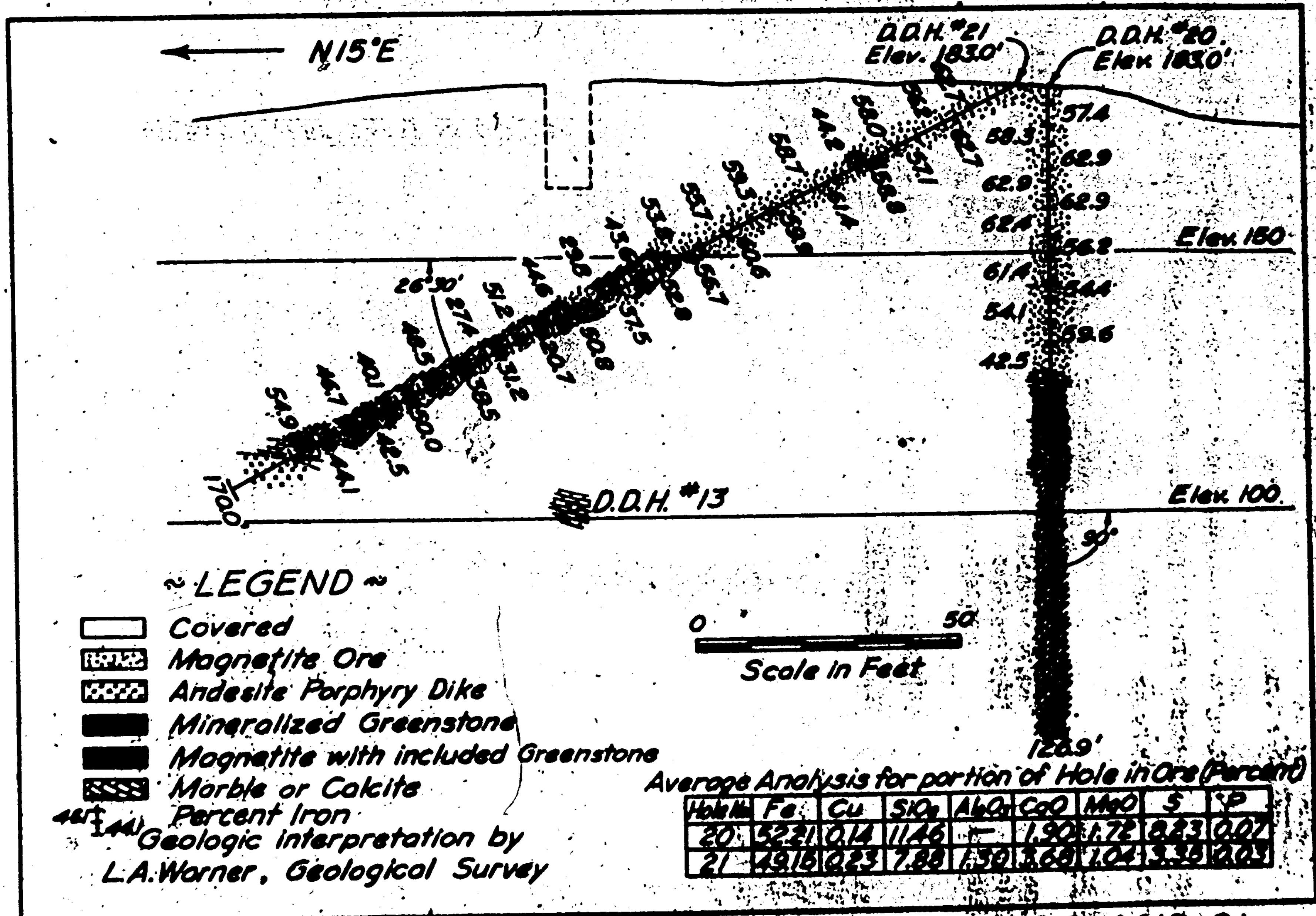
Hole No.	Fe	Cu	SiO_2	CaO	MgO	P	S
11	48.55	0.33	17.90	2.86	0.14	0.01	0.80
12	52.66	0.16	12.94	3.90	0.62	0.01	1.02

FIG. 7-SECTION E-E' ON LINE OF HOLES 11 AND 12



Hole No.	Fe	Cu	SiO2	CaO	MgO	P	S
13	55.87	0.05	9.72	3.34	1.86	0.06	7.88
14	48.99	0.11	11.82	3.44	2.36	0.07	8.83

FIG. 8-SECTION F-F' ON LINE OF HOLES 13 AND 14



Average Analysis for portion of Hole in Ore (Percent)

Hole No.	Fe	Cu	SiO₂	Al₂O₃	CaO	MgO	S	P
20	52.21	0.14	11.46	—	1.90	1.72	0.23	0.07
21	49.16	0.23	7.88	1.50	3.68	1.04	3.36	0.03

FIG. 9 - SECTION G-G' ON LINE OF HOLES 20 AND 21

ation as well as approximately the bottom of the ore as indicated on most of the sections. Inferred ore reserve might be computed as somewhat larger if assumptions could be made as to continuation of ore beyond faults as shown on sections, but not enough information is available to justify such assumptions.

A tonnage factor of 8.25 cubic feet per long ton, computed on a basis of 50 percent iron as magnetite, was used. Table 1 summarizes the several classes of ore reserves:

TABLE 1. - Ore reserves

Block	Length, feet	End areas, sq. ft. South	End areas, sq. ft. North	Volume cu. ft.	Long tons
A - Measured ore:					
1 S. end to AA' . . .	240	0.0	3,153	378,360	45,862
2 AA' - BB'	190	3,153	6,680	934,135	113,229
3 BB' - CC'	380	6,680	4,272	2,080,880	252,228
4 CC' - DD'	193	4,272	3,812	780,106	94,558
5 DD' - EE'	225	3,812	10,006	1,554,525	188,427
6 EE' - FF'	172	10,006	9,015	1,635,806	198,280
7 FF' to N. end . .	180	9,015	0.0	811,350	98,345
	1,580			8,175,162	990,929
		For purposes of this report . .			990,900
B - Indicated ore:					
1 S. end to AA' . . .	240	0.0	1,000	120,000	14,546
2 AA' - BB'	190	1,000	1,525	239,875	29,076
3 BB' - CC'	380	1,525	425	370,500	44,909
4 CC' - DD'	193	425	630	101,808	12,340
5 DD' - EE'	225	630	1,112	195,975	23,755
6 EE' - FF'	172	1,112	2,066	273,308	33,128
7 FF' to N. end . .	180	2,066	0.0	185,940	22,538
	1,580			1,487,406	180,292
		For purposes of this report . .			180,300
C - Inferred ore:					
1 S. end to AA' . . .	240	0.0	1,900	228,000	27,636
2 AA' - BB'	190	1,900	1,200	294,500	35,697
3 BB' - CC'	380	1,200	170	260,300	31,552
4 CC' - DD'	193	170	1,150	127,380	15,440
5 DD' - EE'	225	1,150	1,987	352,912	42,777
6 EE' - FF'	172	1,987	2,325	370,832	44,949
7 FF' to N. end . .	180	2,325	0.0	209,250	25,364
	1,580			1,843,174	223,415
		For purposes of this report . .			223,400
Grand total, measured, indicated, and inferred					1,394,636
		For purposes of this report . .			1,394,600

DEVELOPMENT

Development consists of 19 trenches, 10 to 120 feet in length, generally crosscutting the ore; 3 short adits, 35, 100, and 90 feet in length, also crosscutting ore; and 4 shallow shafts, 15, 60, 20, and 10 feet in depth. Of these shafts, the second connects with No. 2 adit and extends about 30 feet below the adit track level. All shafts were filled with water and, because of the absence of pumping equipment, were not drained during the course of the Bureau's examination. Appearance of the dumps seems to confirm the report that Nos. 1, 2, and 3 shafts were generally in ore to the bottoms and that No. 4 shaft encountered only alluvium and glacial till.

The ore is hard and firm. Country rock, mostly greenstone, is also firm, with only small cracks and seams. Several faults were noted, none of which was large enough to cause trouble in mining. No timbering has been done except at shaft collars, and none is believed to be necessary in mining.

Because of the heavy rainfall in the district, considerable water is encountered in the mine workings close to the surface, but no trouble is expected from water in opencut mining operations. As mining progresses below natural drainage, pumps will be necessary, but pumping lifts will never be over 100 feet, and the amount of water will be only the amount of rain falling into the area of the pit plus a certain amount of seepage.

There is no equipment on the property. An old rail tram from the beach to the No. 3 adit has entirely rotted out, and the dock is gone. Two cabins at the beach are now used as dwellings and are not available for other use.

No work is being done on the property at this time.

PROPOSALS

Operation of this property depends upon the establishment of an iron industry in the Northwestern States, perhaps in the vicinity of Seattle or Tacoma. It is understood that some study of the problem has been made by State Planning Boards and others.

If such an iron industry is to be established, the Poor Man deposit would be attractive as a source of ore because of its favorable location close to deep-water transportation, the possibility of year-round operation, and the high iron content of the ore.

MINING

The trenching and core drilling already done, together with results of sampling trenches and drill holes, is considered to prove adequately the tonnage and grade of the ore body.

Topography and shape of the ore body are favorable for a simple openpit operation. It is believed that the ore can best be mined by starting at the south end at about 50 feet elevation, stripping the thin overburden of 2 to 5 feet, drilling and blasting the ore from benches advancing northward, shoveling into cars or trucks, transporting to dock, loading into steamers or, preferably, barges, and shipping to point of use.

The eastern side or footwall of the ore body dips about 60° westerly, and the rock is firm enough to stand at that angle, eliminating the necessity of cutting back the slope on that side. On the west side, the wall will overhang and must be cut back, probably to a 50° angle because of the irregular shape of the ore hanging wall, as indicated by drill holes. The amount of this hanging wall to be removed will finally amount to 789,900 long tons, or 0.566 ton of waste for each ton of ore. There is ample space to the west and south of the ore body for disposal of stripping. Part of this stripped material can be used to build a solid roadbed from the mine to the beach and from high-tide line to deep water. A 16-foot roadbed with 1.5 to 1 side slopes, level from the south end of the ore body to 500 feet out from the high tide mark, would require the use of 176,730 long tons of this waste rock.

The cost of producing crude ore is estimated as follows:

	Per long ton
Clearing land and stripping overburden	$0.10
Breaking	.25
Loading	.17
Tramming	.17
Sorting	.11
Pumping	.01
Supervision	.08
Repairs and maintenance	.10
Overhead and incidentals	.07
Loading ore on ship or barge	.11
	1.17

Cost of mining and disposing of waste on the sides of ore body is estimated as follows. These are direct charges only, supervision and overhead being charged to ore extraction:

	Per long ton
Clearing land	$0.05
Breaking	.22
Loading	.17
Tramming	.17
Dumping and maintenance of waste dumps	.05
	.66

At 0.566 ton of waste for each ton of ore, the cost of waste disposal is $0.37 per ton of ore.

Total mining cost is estimated to be $1.17 plus $0.37, or $1.54 per long ton.

Cost of Mine Plant

Compressor, including motor and drive	$15,000
Drills, with steel, bits, hose, and accessories	10,000
Diesel power shovel for ore	20,000
Diesel power shovel for waste and stripping	20,000
Tractor bulldozer with winch	15,000
Machine and blacksmith shop and equipment	10,000
2 Diesel-electric power units with switchboard installed	16,000
Power line to pit, with lighting transformers and floodlights at pit	5,000
Road from beach to deposit, 1,500 feet	15,000
2 Pumps, with motors and float switches, installed	2,000
Four 5-ton trucks, for ore	8,000
Four 5-ton trucks, for waste	8,000
Dock and ore bunkers, complete with ore loading conveyor	50,000
Camp buildings and equipment	30,000
	224,000

Saw Mill

Because of the abundance of local timber, it may be advisable to set up a saw mill on the property. Cost of saw mill will be charged against cost of dock, ore bunkers, shop, and camp buildings.

Pumping

No pumping will be necessary until ore is mined from the pit at elevations below Poor Man Creek or at elevations below 50 feet above sea level. Below this elevation, mining is proposed to 50 feet below sea level. For a mining period of approximately 1-1/2 years, pumping against a maximum static head of 100 feet, or average head 50 feet, will be required.

With a drainage area of 135,330 square feet over the entire pit and probable maximum rainfall of 5 inches in 24 hours, a pump handling 300 gallons a minute at 100-foot head would handle the anticipated water. A single-stage, centrifugal, electrically driven pump equipped with a float switch for automatic starting and stopping and not requiring an attendant, with power line from pump to edge of pit, would cost $1,000. Two such pumps should be provided.

Power Plant

As it is proposed to operate the mine day and night, it will be necessary to provide lighting over the pit area, at the shops, camp and dock by installing a suitable Diesel-electric plant. A plant using two medium-speed, 4-cycle, 100-horsepower engines directly connected to 440-volt, 3-phase, alternating-current generators will provide power enough to operate the compressor, pumps, and ore-loading conveyor at the dock as well as lights. Duplicate units are proposed, but only one need be operated during most of the day shift. Cost of the power plant is estimated at $16,000 installed. The power line to the edge of the pit, lighting transformers, and floodlights over the pit are estimated to cost $3,000. Cost of other lighting equipment is included in estimates for cost of camp, shops, and dock.

MILLING

Results of tests conducted at the Rolla laboratory of the Bureau of Mines on samples of ore from surface trenches on the Poor Man deposit indicate that the ore is amenable to beneficiation by magnetic separation, or by flotation followed by magnetic separation of flotation tailing. Magnetic separation of coarsely ground ore, 10-mesh, was not successful because particles of magnetite and siliceous material were locked and not completely freed at grinds coarser than 65-mesh.

Best results were obtained by flotation of comparatively coarsely ground (35-mesh) ore followed by magnetic separation of tailing from flotation. Ore of the following analysis was used in these tests: 52.4 percent Fe, 12.3 percent SiO_2, 14.2 percent insoluble, 2.07 percent S, 0.09 percent Cu, and 0.09 percent P. The first tests were made in a wet, low-intensity, magnetic separator on portions of the ore ground to pass 10-mesh, 48-mesh, and 65-mesh screens. Concentration of 10-mesh material was negligible. At 48-mesh, a high-grade magnetic product low in silica and phosphorus was obtained, but the sulfur content was above the maximum allowable for iron ores. At 65-mesh, the sulfur content of the magnetic portion was 0.09 percent, half of that at 48-mesh, but still considerably in excess of the maximum of 0.04 percent.

A portion of the ore was stage-ground in a pebble mill to pass 35-mesh and floated at 25 percent solids in a mechanical cell to remove the sulfides. The sulfide rougher concentrate was cleaned once, and the cleaner tailing was combined with the rougher tailing. This material was reserved for magnetic-separation tests. Examination of the sulfide concentrate showed it to be chiefly sulfides of iron, together with calcite; no oxides of iron were noted. The selective flotation of the small amount of copper-bearing minerals was not successful.

Flotation results

Product	Weight, percent	Chemical analysis, percent					Percent of total				
		Fe	S	SiO_2	P	Cu	Fe	S	SiO_2	P	Cu
Concentrate	4.7	42.9	41.7	0.4	0.01	1.0	3.8	89.5	0.2	0.6	71.2
Tailing . .	95.3	53.9	0.24	11.1	0.09	.02	96.2	10.5	99.8	99.4	28.8
Head calculated . .	100.0	54.4	2.19	10.6	0.09	0.07	100.0	100.0	100.0	100.0	100.0

Magnetic separation of the tailing was made in a wet, low-intensity, magnetic separator. The iron recovered substantially represents the recovery of magnetite.

Magnetic separation data

Product	Weight, percent	Analysis, percent				Percent of total	
		Fe	S	SiO_2	P	Fe	S
Magnetic concentrate . .	76.8	66.8	0.02	5.3	0.03	94.3	6.2
Nonmagnetic tailing . . .	23.2	13.4	1.00	-	-	5.7	93.8
Feed calculated	100.0	54.4	0.25	-	-	100.0	100.0

Another flotation and magnetic separation test was made as described above, except that the ore was ground through 65-mesh. Further unlocking of the deleterious constituents was evident from the magnetic-concentrate analysis, which was 67.1 percent iron, 0.003 percent sulfur, 4.9 percent insoluble, and 0.008 percent phosphorus. Iron recovery was 93.9 percent.

Finer grinding of the crude ore followed by magnetic separation probably would produce an acceptable magnetic concentrate. However, the flotation procedure at the relatively coarse mesh seems desirable for three reasons - (1) the ease with which flotation is accomplished, (2) the removal of the sulfides also reduces the amount of material to be magnetically treated, and (3) the flotation concentrate is a potential source of sulfuric acid and iron sinter, and grinding costs would be considerably reduced, probably offsetting the extra cost of flotation.

Samples taken from core drilling contain a higher percentage of copper, and there is less oxidation than in material used in the tests described above. The value of gold, silver, and copper in an average of all ore amounts to $2.27 a long ton at present (January 1944). Recovery of 70 percent of these values, or $1.59 a long ton, by bulk flotation of sulfides can reasonably be expected. Such a concentrate would be readily salable at the Tacoma, Wash., smelter, and receipts from such sales would cover most of the cost of milling and sintering the iron ore, estimated at $1.75 a ton, as follows:

Milling - direct cost

	Per long ton
Crushing and screening	$0.19
Grinding and classifying	.34
Flotation and magnetic separation	.20
Dewatering, sampling, and assaying	.12
Repairs and maintenance	.05
Supervision	.05
Marketing concentrates, office and general	.05
	1.00

Sintering - direct cost

Fuel oil	$0.20
Coal screenings, 5 percent of charge	.25
Labor	.12
Supervision	.03
Power and supplies	.10
Repairs and maintenance	.05
	.75

Because of the short life of this property if mined at the planned rate of 1,000 tons a day, and considering a plan to move all equipment from one iron deposit to another on Prince of Wales Island as the deposits were depleted, it is believed best to place concentrating and sintering equipment in the vicinity of the iron furnace, possibly near Seattle or Tacoma, Wash. This plan is feasible because the cost of hauling the low percentage of waste included in the ore to the concentrator would be more than offset by lower construction and operating costs in the States. Further savings in labor and supply costs, in Alaska-bound freight, and in fuel and power costs would be effected by this plan.

Cost of the milling plant for 1,000 tons calculated at $500 a ton of daily capacity would be $500,000. Cost of sintering plant for the same capacity if built in conjunction with the mill would not exceed $100,000. The cost of mining and milling 1,200 tons of ore a day would be approximately the same as calculated for 1,000 tons a day estimated herewith; however, the life of the mine would be proportionately reduced.

ESTIMATED CAPITAL AND OPERATING COSTS

This report does not deal with the furnacing or ore-reduction of the concentrates. Estimates herein are based upon the assumption that production of a high-grade iron sinter from ores of the Prince of Wales Island deposits will go a long way toward encouraging the establishment of a furnace in the Northwestern States area, where power and the presence of required raw materials seem favorable for such an installation.

The total estimated capital expenditure required to implement the mining, milling, and sintering operations, as described in the foregoing paragraphs, is as follows:

Total capital expenditure

Mine plant	$224,000
Mill	500,000
Sintering plant	100,000
Operating capital	150,000
Total sum required	974,000
Less operating capital	150,000
Net capital used	824,000

Amortization

Sum to be retired	$824,000
On each long ton of ore mined = $824,000 ÷ 1,394,600	$0.59
Interest for life of property, plus construction period, on $974,000	0.14
Total amortization and interest for each long ton of ore	0.73

Operating costs

	Per long ton
Mining, including loading on ship or barge	$1.54
Ocean freight, including unloading at mill	1.50
Milling and sintering	1.75
Interest and amortization	0.73
	5.52
Less credit for value of sulfide concentrate	1.59
Net cost of 1 ton of crude ore at furnace after milling and sintering	3.93

VALUE OF PRODUCT

The concentrated and sintered product, containing approximately 67 percent iron, 5.0 percent insoluble material, 0.02 percent sulfur, and 0.02 percent or less phosphorus, is not comparable in value to average-grade Lake Superior ores, but rather to Adirondack magnetite that has been concentrated and sintered. Such ore is superior in quality and is used as premium ore to increase duty of open-hearth furnaces and for electric furnaces making alloy steels. Use of such electric furnaces would be possible in the Puget Sound area because of the availability of abundant, cheap electric power from the Bonneville and Grand Coulee sources.

According to D. B. Gillies, of the Republic Steel Corporation,[5] Adirondack magnetite concentrated and sintered is worth $0.1058 a unit of iron at the furnace.

Using this figure, the Poor Man ore, also concentrated and sintered, would be worth $7.09 a long ton at the furnace. There would be a loss of volume in milling, and the final recovery of iron ore would be about 73.2 percent of the original weight, the rest being the rejected siliceous tailing and the sulfide concentrate, which would be sold separately to the smelter. Considering these factors, the value of concentrated and sintered Poor Man magnetite will be $5.19 a long ton of original ore.

A net profit per ton of ore mined and milled, before royalty and taxes but with mine and mill cost entirely written off (hence, no depreciation) would be $5.19 minus $3.93, or $1.26 a long ton, or $1,757,000 if all of ore reserve is mined.

SCHEDULE OF OPERATIONS

	Days required for each operation
1. Exploration and sampling, as accomplished by the Bureau of Mines, is considered to be completed.	
2. Moving in bulldozer, 1 power shovel, 3 trucks, and sawmill and building camp and road to property.	60

5 Mining and Metallurgy, Adirondack Mining Issue, November 1943, p. 479.

	Days required for each operation
3. Stripping south end of ore body, using waste to improve road, while work on camp, compressor, and shop buildings continue.	30
4. Moving in second power shovel, remaining trucks, and power plant, building dock and ore-loading facilities, power line to mine, and completing stripping of ore, opening benches ready to start mining.	90
Total to begin production	180

5. During this same period, the mill and sintering plant could be constructed so that production and milling of ore can begin within 6 months of starting work.

CONCLUSIONS

Results of drilling indicate 990,900 long tons of 52.4 percent iron ore, measured, available at Poor Man, with 180,300 long tons indicated and 223,400 long tons inferred ore of approximately the same grade, a total reserve of 1,394,600 long tons.

Ore-dressing tests indicate that flotation of coarsely ground ore followed by magnetic separation of the tailing will produce an iron concentrate containing 67 percent iron, within permissible limits as to impurities, and probably a bulk sulfide flotation concentrate containing enough copper, gold, and silver to pay the cost of all milling and most of the cost of sintering the iron ore.

Concentrating and sintering plant should be built at or near the site of an iron furnace, probably in the Puget Sound area. Freight by water from mine to mill should not exceed $1.50 a ton. Barge transportation is recommended because no primary crushing of the material to be loaded would be required. If material is transported by steamers, the primary crushing unit would be installed at the loading dock and eliminated at the mill. Costs would be comparable in either case.

It is estimated that by mining at the rate of 1,000 tons a day and recovering the total estimated reserve, life of the deposit will be 4.649 years and total profit will be $1,757,000 before taxes and royalty, but with complete depreciation of plant. The deposit could be mined at the rate of 1,200 tons a day at approximately the same cost as estimated in this report; however, the life of the deposit would be proportionately lessened.

Construction can be completed and mine, mill, and sintering plant put into operation within 6 months after starting work. The Bureau of Mines recommends that private industry or Federal or State agencies that may be considering the advantages of the installation of an iron furnace in the Pacific northwest consider the Poor Man deposit on Prince of Wales Island as a potential source of ore amenable to simple concentration and production of a high-grade iron sinter.

oOo

47739