R. I. 4406 FEBRUARY 1949

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

BUREAU OF MINES
JAMES BOYD, DIRECTOR

REPORT OF INVESTIGATIONS

INVESTIGATION OF BIG BEN MOLYBDENUM DEPOSIT

NEIHART DISTRICT, CASCADE COUNTY, MONT.

BY

J. A. HERDLICK

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February 1949.

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INVESTIGATION OF THE BIG BEN MOLYBDENUM DEPOSIT, NEIHART DISTRICT, CASCADE COUNTY, MONT.[1/]

By J. A. Herdlick[2/]

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INTRODUCTION AND SUMMARY

At the request of the War Production Board a preliminary examination of the Big Ben molybdenum prospect near Neihart, Cascade County, Mont., was made

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Report of Investigations 4406."

2/ Mining engineer, Bureau of Mines, Mining Division, Albany Branch, Albany, Oreg.

by the Bureau of Mines under G. N. Bennett, mining engineer, Bureau of Mines Montana district office, in September 1942. Formal investigation, consisting of sampling, core drilling, and metallurgical testing, was later undertaken and completed in 1943. Field work was directed by Robert D. O'Brien, mining engineer, Montana district office, under the supervision of E. W. Newman, supervising engineer, Montana district office. This report describes the deposit, presents the factual data obtained from the sampling and core-drilling operations, and summarizes the results of the metallurgical studies.

The deposit was first located and prospected in 1922 by the present owner, Frank Mansikka of Neihart, Mont. Periodic examinations made by responsible mining interests were culminated in 1938 when the Federal Mining & Smelting Co. optioned and investigated the property. No ores have been produced from the deposit to date.

The Big Ben deposit is in an area of moderate relief about 2-1/2 miles by road northeast of Neihart, Mont. The topography of this area is such that the property could be exploited by open-cut methods. Molybdenite and several associated sulfide minerals occur in irregular veinlets and disseminations within a stockwork of quartz-porphyry and diorite.

Although the full extent of the mineralized zone was not determined, core-drill holes and adits penetrated a prism 520 feet long, 270 feet wide, and 365 feet deep. Weighted averages of the core samples ranged from 0.19 to 0.26 percent MoS_2. Samples channeled over a length of 295 feet in the lower adit ranged from 0.01 to 0.32 percent MoS_2 and averaged 0.21 percent MoS_2.

Metallurgical testing indicates that concentrates containing 84 to 88.9 percent MoS_2 can be produced by standard ore-dressing methods.

ACKNOWLEDGMENTS

Officials of the Federal Mining & Smelting Co., Wallace, Idaho, gave valued aid by releasing sampling and geological data and by assisting in the Bureau's preliminary examination of the property.

The Federal Geological Survey cooperated in the investigation by mapping the geology of the area and logging the drill cores.

LOCATION AND ACCESSIBILITY

The Neihart mining district is in the central part of the Little Belt Mountains in the Lewis and Clark National Forest, Cascade County, Mont. The town of Neihart is on U. S. Highway 89, about 61 miles southeast of Great Falls or 43 miles north of White Sulphur Springs; it is the terminus of a branch line of the Great Northern Railroad out of Great Falls, Mont.

The Big Ben molybdenum property is 2-1/2 miles northeast of Neihart on the north slope of Poverty Ridge between Snow and Carpenter Creeks. The mine is easily accessible from Neihart over 4-1/2 miles of good road (fig. 1).

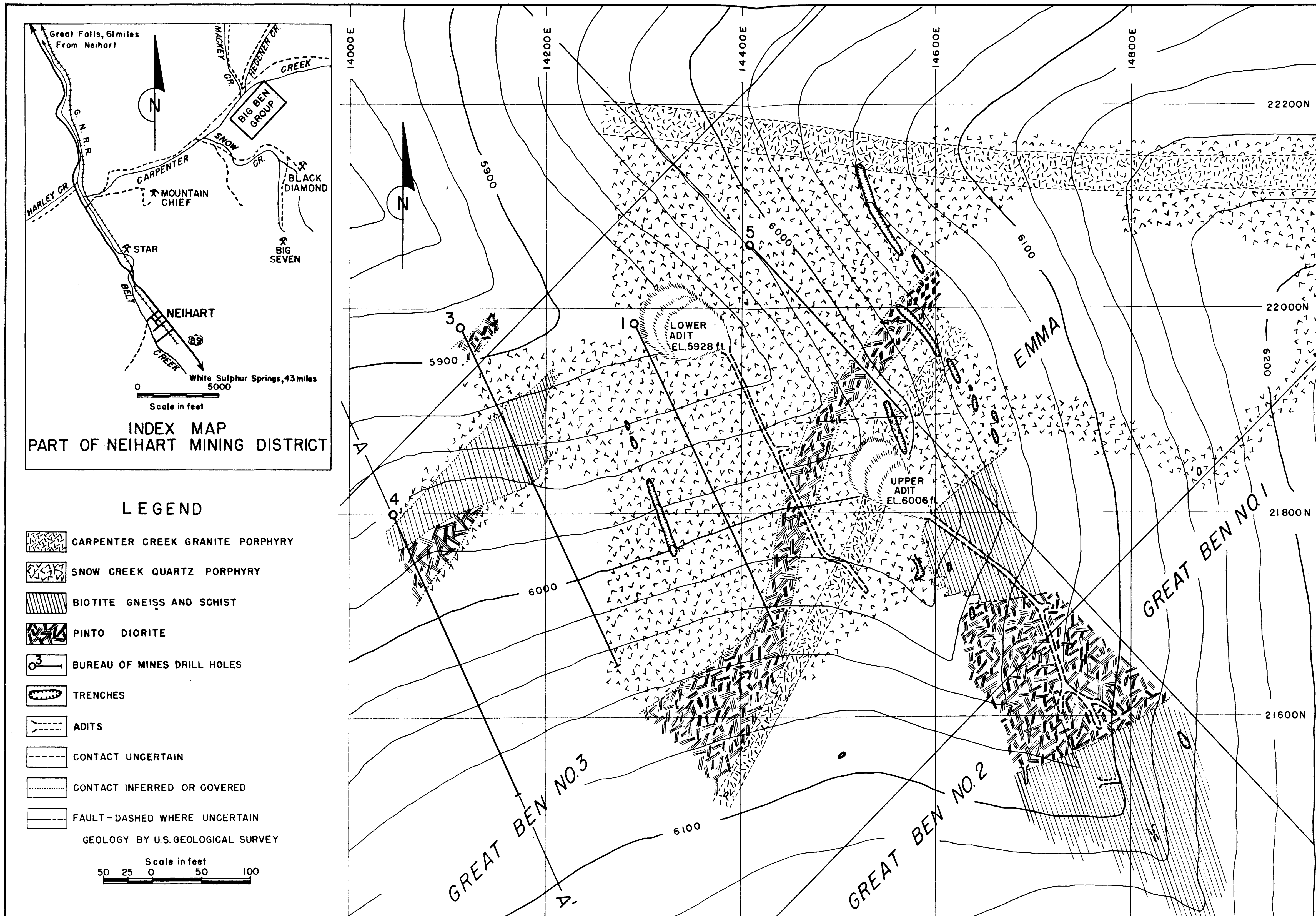

Figure 1. - Surface, geologic, and development plan, Big Ben molybdenum deposit, Cascade County, Mont.

HISTORY AND PRODUCTION

The Neihart mining district has been active intermittently since 1881. Silver has been the principal product, although some lead and zinc are recovered from the silver ores. No commercial shipments of molybdenite have been made from the district.

The Big Ben molybdenum deposit was not located until 1922. In August of that year, Frank Mansikka of Neihart located three lode claims. Five additional lode-claim locations and a mill-site location were recorded between 1923 and 1940. During that period, Mansikka drove two adits, 290 feet and 300 feet long, respectively, to explore the molybdenum deposit. The work was done by hand-mining methods under difficult conditions; it proved disappointing in that no shipping-grade ore was encountered.

The Big Ben property is reported to have been examined by the Climax Molybdenum Co., Anaconda Copper Mining Co., and U. S. Vanadium Corp. In 1938 the Federal Mining & Smelting Co. obtained an option on the property and did considerable surface trenching to supplement a program of sampling and geological study of the deposit.

PHYSICAL FEATURES AND CLIMATE

Neihart is in the valley of Belt Creek at an altitude of 5,600 feet. The altitude of the explored part of the Big Ben deposit ranges from about 5,900 feet to 6,200 feet. Although in a mountainous region, the deposit is in an area of comparatively moderate relief; most of the slopes are under 25°.

Overburden in the mineralized area ranges from 3 to 15 feet in depth and supports a thick growth of lodge-pole pine. Larger timber, suitable for mine support, is available in the district.

The Big Ben property includes a mill site on Carpenter Creek. This stream has a year-round flow sufficient for a 500-ton milling plant. Tailings-disposal sites are not available on the property but may be obtained in the valley of Carpenter Creek.

The climate is typical of all mountainous regions in Montana. The summers are dry and cool; winters are severe. Snow is common after November 1 and usually covers the ground until June. The main highway through Neihart, and the railroad, are maintained regularly. During the winter, mine access roads are cleared as occasion demands.

The facilities of the Montana Power Co. serve the district. Electric power at favorable rates is available.

LABOR SUPPLY AND LIVING CONDITIONS

Some skilled mine labor normally is available at Neihart. Large crews usually can be recruited at near-by centers, such as Butte, Helena, and Great Falls. Board and lodging for small crews and some family housing facilities are obtainable at Neihart.

PROPERTY AND OWNERSHIP

The Big Ben property, owned by Frank Mansikka of Neihart, comprises 180 acres divided into eight unpatented lode claims and one unpatented mill site. The claims are listed as follows:

TABLE 1. - Claim names and dates of location, Big Ben property, Cascade County, Mont.

Unpatented claims	Date recorded
Great Ben No. 1	Aug. 9, 1922
Great Ben No. 2	Do.
Great Ben No. 3	Do.
Lone Star	July 27, 1926
Emma	Do.
Titanic	Jan. 27, 1927
Butte	July 23, 1930
June	May 14, 1940
Great Ben mill site	June 21, 1940

MINE WORKINGS

Development work consists of an adit 290 feet long, an adit 300 feet long, and numerous surface trenches. The upper adit, at an altitude of 6,006 feet, is driven 290 feet southeasterly in the mineralized zone. The face of the lower adit is almost directly under the portal of the upper adit and about 78 feet vertically lower. The two adits are approximately in line; consequently, they explore the mineralized zone throughout a horizontal distance of 540 feet. Short drifts and crosscuts, whose aggregate length is about 75 feet, are driven on the more highly mineralized fissures exposed in the adits (fig. 1). A series of trenches, whose combined length is about 500 feet, were dug by the Federal Mining & Smelting Co. in 1938.

DESCRIPTION OF DEPOSIT

The geology of the Little Belt Mountains, including the Neihart district, has been described in an early report by Weed.3/ A later report by Schafer4/ reviews and supplements general information on the district and gives additional data on individual mines and prospects. During the Bureau of Mines investigations, the Federal Geological Survey made a detailed examination of the Big Ben area and later published a report describing the molybdenum deposit.5/

3/ Weed, W. H., Geology of the Little Belt Mountains, Mont.: Geol. Survey 20th Ann. Rept., pt. 3, 1898-99, pp. 271-459.

4/ Schafer, P. A., Geology and Ore Deposits of the Neihart Mining District, Cascade County, Mont.: Montana Bureau of Mines and Geol., Mem. 13, 1935.

5/ Creasey, S. C., and Scholz, E. A., Big Ben Molybdenum Deposit, Neihart Mining District, Cascade County, Mont.: Geol. Survey Preliminary Report, 1944, 29 pp.

The following description of the geology of the deposit is summarized mainly from the preceding reports.

Geology-General

The Little Belt Mountains are an uplifted plateau or broad east-west-trending arch that has been dissected by stream erosion. Intrusions in the form of loccoliths, stocks, sheets, and dikes modify the fold. The Neihart district is approximately on or slightly north of the axis of the fold. The principal rocks are Archean gneisses and schists, Beltian quartzites and shales, two types of younger porphyries (post-Cretaceous), and a partly gneissoid diorite of unknown age.

Four of the principal rock types in the Big Ben area have been identified. The Archean rocks are represented by biotite schist and biotite gneiss intruded by small dikes and irregular masses of partly gneissoid diorite, locally called Pinto diorite because of the presence of large, closely-spaced masses of feldspar with interstitial green amphibole. A rhyolite porphyry, locally called Snow Creek quartz porphyry, is the principal rock in the Big Ben area. It occurs as a large, intrusive mass extending from the headwaters of Snow Creek to the divide at the head of Hegener and Mackay Creeks. The intrusive, which is 3 miles long and 1,000 to 2,500 feet wide, has fairly regular boundaries, although numerous tongues extend far out from the main body. At the Big Ben mine, the Snow Creek quartz porphyry occurs as masses and as dikes, cutting both the Archean gneisses and schists and the Pinto diorite.

Dikes of granite porphyry (Carpenter Creek granite porphyry) are numerous in the district, but only two such dikes have been mapped in the vicinity of the Big Ben deposit; they intrude the Snow Creek porphyry and the older formations. The granite porphyry is easily distinguished from the other rocks by its conspicuous color, cuased by numerous phenocrysts of pink orthoclase.

The Deposit

The extent of mineralization and the character of the Big Ben deposit are difficult to determine because of the poor surface exposures in the vicinity of the mine and the intricate relationships of the rocks exposed in the trenches and adits. The deposit appears to be a stockwork in which molybdenite and associated sulfide minerals occur mainly in irregular fractures but also, to a minor extent, as disseminations in silicified zones in the country rock. Most of the fractures are quartz-filled, and many contain some molybdenite; their attitudes differ widely. Stronger fractures, or mineralized faults of small displacement, have preferred trends from N. 20° E. to N. 85° E. and steep angle dips to both the north and south. However, the stronger fractures, although more intensely mineralized, appear to be of limited extent.

Molybdenite mineralization in the explored area is strongest in the Snow Creek quartz porphyry and Pinto diorite. Biotite gneiss was encountered in all of the drill holes except hole 5 and is exposed in both adits. Although the degree of mineralization in the gneiss differs from place to place, the average metal content of the samples from the gneiss is lower than the average from either the Snow Creek quartz porphyry or Pinto diorite formations.

The Carpenter Creek granite porphyry, which occurs as dikes cutting the other rocks, is only slightly mineralized. The granite porphyry has a conspicuous pink color, which easily distinguishes it from the other formations.

Four drill holes and the lower Big Ben adit explore a mineralized area approximately 520 feet long and 270 feet in average width, within a vertical range of about 365 feet. The vertical projection of the explored mineralized area approaches the form of a parrallelogram, with the long axes extending northeasterly. However, the actual shape and extent of the deposit are unknown because the adits and the drill holes do not delimit the molybdenum mineralization either laterally or in depth.

The upper adit, although outside the explored part of the higher-grade zone, is mineralized throughout its entire length; the degree of mineralization increases toward the face. This adit and the dumps of some old caved surface and underground workings indicate that the molybdenite zone extends at least 250 feet south of the area explored by the drill holes and the lower adit. Schafer[6/] mentions the presence of molybdenite on Snow Creek, which is about 2,500 feet southward from the Big Ben workings; he also mentions mineralization in the vicinity of Hegener and Mackay Creeks, which are half a mile and more north of the Big Ben. Both of these areas are in the same band of Snow Creek quartz porphyry in which the Big Ben deposit occurs.

Surface prospecting in the area is made difficult and inconclusive by the dense stand of lodgepole-pine timber, by the depth of the overburden, and possibly by impoverishment of some parts of the molybdenum outcrops. Evidence exposed in surface trenches and subsequently in drill cores, although not conclusive, strongly suggests that the molybdenite was partly leached to a depth of 15 to 20 feet below the overburden. These conditions are important factors to be considered in planning development of the deposit or its exploitation by open-pit mining methods.

The Ore

Molybdenite, the principal ore mineral, is associated with pyrite and quartz and with minor amounts of galena, chalcopyrite, and fluorite. The galena and molybdenite are associated intimately. Molybdite (hydrous ferric molybdate) partly replaces the molybdenite to a depth of 15 to 20 feet below the overburden. The presence of tungsten has been noted, but samples taken by the Bureau of Mines indicate that the average WO_3 content will not exceed 0.01 percent.

In general, the higher-grade molybdenite mineralization occurs in a stockwork of quartz veinlets and mineralized fractures and as disseminations

6/ Work cited in footnote 4, p. 4.

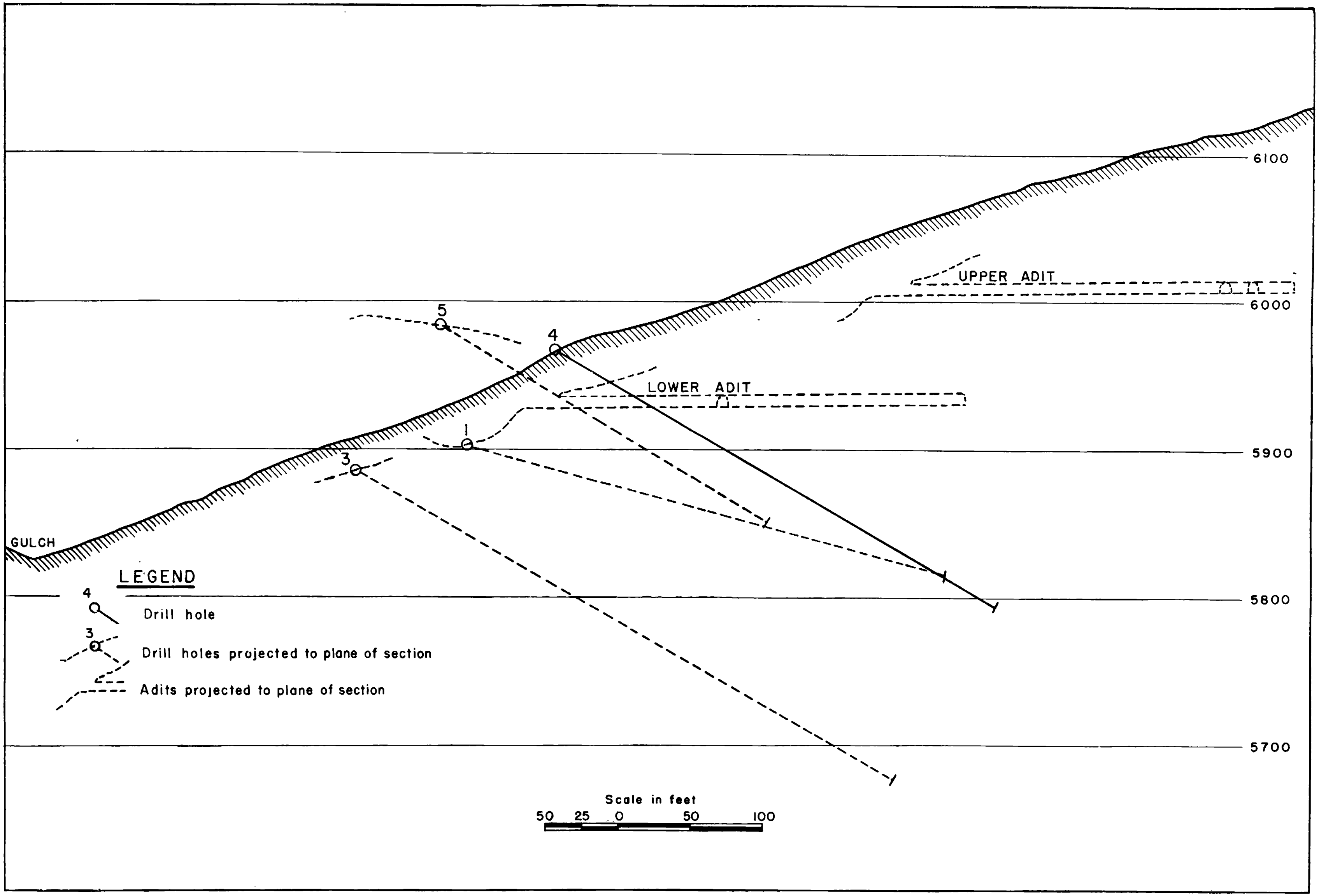

Figure 2. - Vertical section A-A' through hole 4, Big Ben molybdenum deposit, Cascade County, Mont.

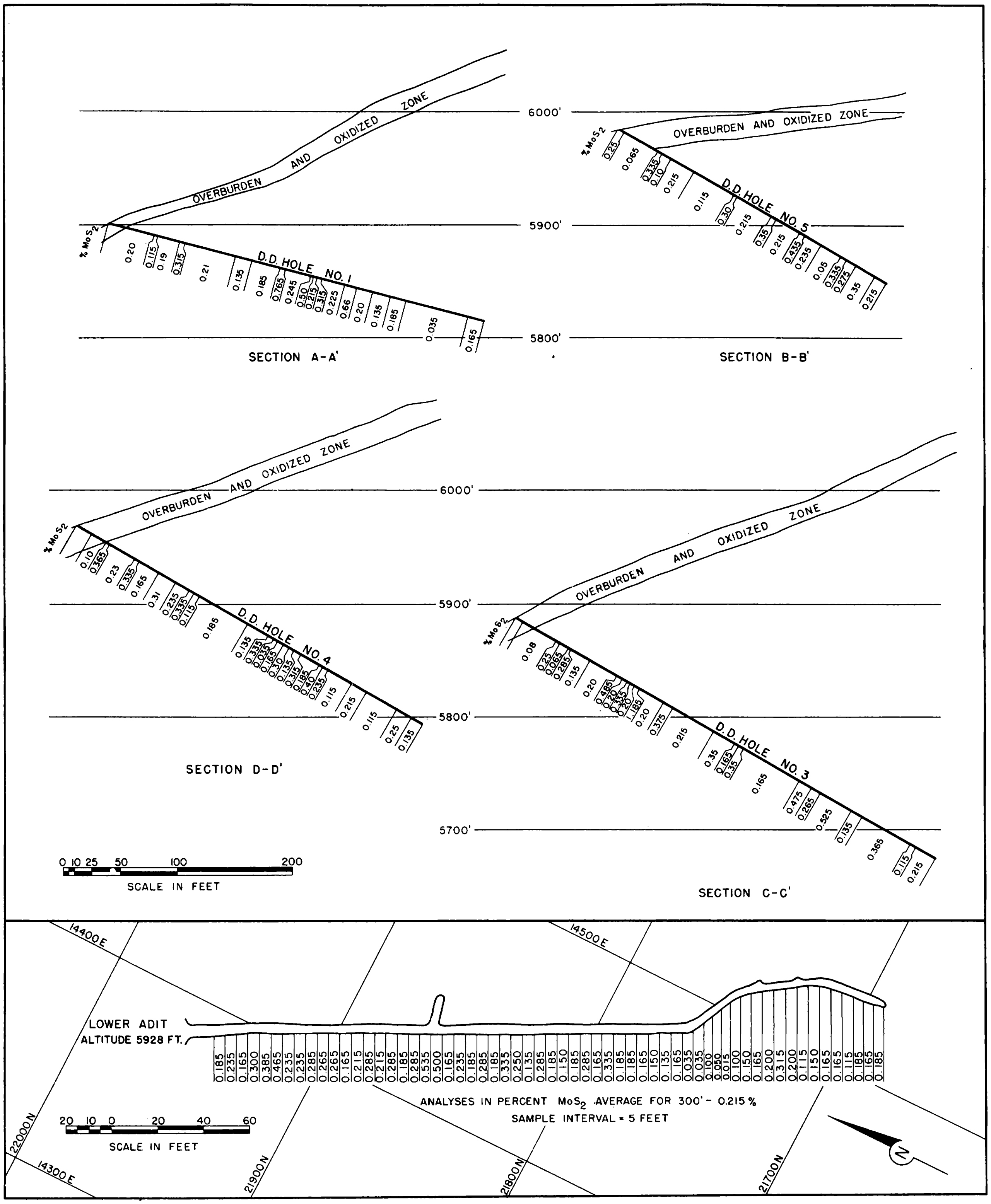

Figure 3. - Drill-hole sections and assays, and assay plan of lower adit, Big Ben molybdenum deposit, Cascade County, Mont.

in silicified zones. Locally, the country rock is altered intensely. Silicified zones are common in the Snow Creek quartz porphyry and, to a lesser extent, in the Pinto diorite. Kaolinized zones occur in the Pinto diorite, gneisses, and occasionally in the Snow Creek quartz porphyry. These kaolinized zones are usually characterized by lower-grade mineralization. Some feldspar masses in the Pinto diorite are altered to sticky masses of clay.

WORK BY THE BUREAU OF MINES

The Bureau of Mines investigation of the Big Ben molybdenum deposit was begun August 11, 1943, and completed October 25, 1943. The work included diamond core drilling, channel sampling of underground exposures, metallurgical testing, and surveying.

Diamond Core Drilling

Four drill holes, whose combined length was 1,385 feet, were completed under contract. Except for some loss of core in faulted sections, drilling conditions, in general, were favorable: The holes were cased to AX size to depths of 10 feet to 34 feet below the collars; no cementing or further casing was necessary.

The entire core recovered from the four holes was forwarded to the Bureau of Mines at Reno, Nev., for analysis. All samples were analyzed for molybdenum and lead; 17 were analyzed for copper, gold, and silver. Lead was reported at less than 0.1 percent in all samples. The copper content ranged from less than 0.02 percent to a maximum of 0.13 percent, an average of less than 0.047 percent in the 17 samples. These 17 samples contained a trace of gold and no silver.

The drill holes are shown in plan in figure 1, and in section in figures 2 and 3. Summarized drill-hole data and the results of core analyses are given in the following tables.

TABLE 2. - Summary of drill-hole data, Big Ben molybdenum deposit

Hole No.	Altitude at collar, feet	Length, feet	Inclination, degrees	Bearing, azmuth	Core samples analyzed, number	Core recovery, percent	Drilling rate, ft./shift
1...	5,903	340	-15	S. 26° E.	70	80	14.17
3...	5,887	424	-30	S. 26° E.	84	74	16.33
4...	5,968	350	-30	S. 26° E.	68	57	19.44
5...	5,985	271	-30	S. 44° E.	53	68	19.36
4		1,385			275	1/70	1/16.89

1/ Average

TABLE 3. - Core-sample analyses, Big Ben molybdenum deposit

Interval, feet From-	Interval, feet To-	Sample length, feet	Molybdenum, percent
Hole 1			
0.0	3.5	3.5	0.06
3.5	7.0	3.5	.09
7.0	12.0	5.0	.13
12.0	15.5	3.5	.11
15.5	20.0	4.5	.16
20.0	22.0	2.0	.18
22.0	26.5	4.5	.14
26.5	31.0	4.5	.11
31.0	36.5	5.5	.11
36.5	42.0	5.5	.10
42.0	45.0	3.0	.07
45.0	50.0	5.0	.13
50.0	55.0	5.0	.10
55.0	60.0	5.0	.11
60.0	65.0	5.0	.12
65.0	70.0	5.0	.19
70.0	75.0	5.0	.13
75.0	80.0	5.0	.12
80.0	85.0	5.0	.16
85.0	90.0	5.0	.13
90.0	95.0	5.0	.14
95.0	100.0	5.0	.09
100.0	105.0	5.0	.17
105.0	111.0	6.0	.10
111.0	116.0	5.0	.09
116.0	120.0	4.0	.08
120.0	125.5	5.5	.10
125.5	130.0	4.5	.06
130.0	135.0	5.0	.13
135.0	140.0	5.0	.09
140.0	145.0	5.0	.11
145.0	150.0	5.0	.11
150.0	155.0	5.0	.12
155.0	160.0	5.0	.46
160.0	165.0	5.0	.13
165.0	170.0	5.0	.15
170.0	178.0	8.0	.14
178.0	183.0	5.0	.17
183.0	185.5	2.5	.30
185.5	189.5	4.0	.13
189.5	193.5	4.0	.19
193.5	198.5	5.0	.14
198.5	204.0	5.5	.14
204.5	209.5	5.0	.15
209.5	213.5	4.0	.10
213.5	219.0	5.5	.52
219.0	224.5	5.5	.25
224.5	230.0	5.5	.11
230.0	235.0	5.0	.13
235.0	239.5	4.5	.12
239.5	244.5	5.0	.07
244.5	250.0	5.5	.11
250.0	255.0	5.0	.06
255.0	260.0	5.0	.14
260.0	264.5	4.5	.10
264.5	269.5	5.0	.09
269.5	275.0	5.5	.07
275.0	277.5	2.5	.05
277.5	284.5	7.0	.03
284.5	290.0	5.5	.01
290.0	295.5	5.5	.01
295.5	300.0	4.5	.01
300.0	305.0	5.0	.01
305.0	310.0	5.0	.01
310.0	312.5	2.5	.02
312.5	320.0	7.5	.02
320.0	325.0	5.0	.02
325.0	331.0	6.0	.11
331.0	337.0	6.0	.09
337.0	340.0	3.0	.12
Total		340.0	

Weighted average, 0.1185 percent Mo.
Weighted average, 0.197 percent MoS_2.

Interval, feet From-	Interval, feet To-	Sample length, feet	Molybdenum, percent
Hole 3			
0.0	8.0	No sample	
8.0	14.5	6.5	0.05
14.5	19.0	4.5	0.02
19.0	23.5	4.5	.03

TABLE 3. - Core-sample analyses, Big Ben molybdenum deposit (Cont'd.)

Interval, feet		Sample length,	Molybdenum,	Interval, feet		Sample length,	Molybdenum,
From-	To-	feet	percent	From-	To-	feet	percent
23.5	29.5	6.0	0.03	216.5	221.0	4.5	0.21
29.5	35.0	5.5	.07	221.0	225.0	4.0	.10
35.0	40.0	5.0	.08	225.0	230.0	5.0	.21
40.0	44.0	4.0	.15	230.0	235.0	5.0	.13
44.0	48.0	4.0	.06	235.0	240.0	5.0	.07
48.0	53.0	5.0	.03	240.0	244.0	4.0	.10
53.0	56.0	3.0	.17	244.0	247.0	3.0	.07
56.0	60.0	4.0	.06	247.0	253.0	6.0	.12
60.0	65.0	5.0	.06	253.0	258.0	5.0	.11
65.0	70.0	5.0	.10	258.0	263.0	5.0	.11
70.0	75.0	5.0	.08	263.0	268.0	5.0	.10
75.0	80.0	5.0	.13	268.0	273.0	5.0	.09
80.0	85.0	5.0	.13	273.0	281.5	8.5	.07
85.0	89.0	4.0	.14	281.5	286.5	5.0	.13
89.0	95.0	6.0	.12	286.5	291.5	5.0	.22
95.0	99.0	4.0	.08	291.5	294.0	2.5	.33
99.0	102.5	3.5	.14	294.0	299.0	5.0	.33
102.5	107.5	5.0	.29	299.0	304.0	5.0	.17
107.5	112.5	5.0	.12	304.0	308.0	4.0	.15
112.5	115.0	2.5	.20	308.0	313.0	5.0	.22
115.0	120.0	5.0	.12	313.0	318.0	5.0	.91
120.0	125.0	5.0	.71	318.0	324.0	6.0	.17
125.0	130.0	5.0	.16	324.0	327.5	3.5	.30
130.0	135.0	5.0	.12	327.5	334.5	7.0	.21
135.0	138.0	3.0	.08	334.5	339.5	5.0	.15
138.0	143.5	5.5	.13	339.5	344.5	5.0	.08
143.5	149.0	5.5	.13	344.5	350.5	6.0	.08
149.0	153.5	4.5	.22	350.5	359.0	8.5	.20
153.5	158.5	5.0	.23	359.0	364.0	5.0	.42
158.5	164.5	6.0	.13	364.0	369.0	5.0	.20
164.5	169.5	5.0	.18	369.0	374.0	5.0	.13
169.5	175.0	5.5	.17	374.0	379.0	5.0	.20
175.0	180.0	5.0	.10	379.0	383.0	4.0	.28
180.0	185.0	5.0	.15	383.0	388.5	5.5	.24
185.0	190.0	5.0	.10	388.5	393.5	5.0	.18
190.0	195.0	5.0	.11	393.5	399.0	5.5	.16
195.0	200.0	5.0	.12	399.0	404.0	5.0	.07
200.0	205.0	5.0	.32	404.0	409.0	5.0	.12
205.0	209.0	4.0	.15	409.0	414.0	5.0	.15
209.0	214.0	5.0	.18	414.0	424.0	10.5	.12
214.0	216.5	2.5	.15				
Total						416.0	

Weighted average, 0.159 percent Mo.
Weighted average, 0.265 percent MoS_2.

TABLE 3. - Core-sample analyses, Big Ben molybdenum deposit (Cont'd.)

Interval, feet From-	Interval, feet To-	Sample length, feet	Molybdenum, percent	Interval, feet From-	Interval, feet To-	Sample length, feet	Molybdenum, percent
				168.0	173.0	5.0	0.09
Hole 4				173.0	178.5	5.5	.08
				178.5	183.5	5.0	.06
0.0	4.5	4.5	0.03	183.5	188.5	5.0	.09
4.5	15.5	No core or sample		188.5	194.0	5.5	.07
15.5	23.0	7.5	.07	194.0	199.0	5.0	.20
23.0	30.0	7.0	.05	199.0	203.0	4.0	.02
30.0	34.0	4.0	.22	203.0	206.0	3.0	.09
34.0	39.0	5.0	.15	206.0	210.0	4.0	.11
39.0	44.0	5.0	.12	210.0	215.0	5.0	.18
44.0	49.0	5.0	.12	215.0	220.0	5.0	.08
49.0	54.0	5.0	.15	220.0	227.0	7.0	.19
54.0	59.0	5.0	.15	227.0	232.0	5.0	.10
59.0	64.0	5.0	.20	232.0	240.0	8.0	.12
64.0	69.0	5.0	.11	240.0	245.0	5.0	.11
69.0	74.0	5.0	.10	245.0	248.5	3.5	.24
74.0	79.0	5.0	.10	248.5	254.0	5.5	.14
79.0	83.0	4.0	.09	254.0	258.0	4.0	.08
83.0	88.0	5.0	.21	258.0	263.0	5.0	.09
88.0	92.5	4.5	.11	263.0	268.0	5.0	.04
92.5	95.5	3.0	.21	268.0	272.0	4.0	.07
95.5	100.5	5.0	.22	272.0	278.0	6.0	.08
100.5	105.0	4.5	.13	278.0	282.5	4.5	.13
105.0	109.0	4.0	.15	282.5	287.5	5.0	.09
109.0	114.0	5.0	.15	287.5	293.0	5.5	.10
114.0	119.0	5.0	.20	293.0	298.0	5.0	.09
119.0	124.5	5.5	.07	298.0	303.0	5.0	.08
124.5	129.5	5.0	.11	303.0	308.0	5.0	.06
129.5	134.5	5.0	.16	308.0	314.0	6.0	.09
134.5	139.5	5.0	.11	314.0	318.5	4.5	.10
139.5	143.5	4.0	.13	318.5	323.5	5.0	.07
143.5	147.0	3.5	.12	323.5	328.5	5.0	.13
147.0	154.0	7.0	.13	328.5	333.5	5.0	.16
154.0	158.0	4.0	.10	333.5	338.0	4.5	.15
158.0	163.0	5.0	.05	338.0	343.0	5.0	.08
163.0	168.0	5.0	.10	343.0	350.0	7.0	.05
Total						334.5	
Weighted average, 0.115 percent Mo.							
Weighted average, 0.192 percent MoS_2.							
Hole 5							
0.0	6.0	6.0	0.15	24.5	26.0	1.5	0.03
6.0	10.0	4.0	.05	26.0	31.0	5.0	.03
10.0	15.5	5.5	.04	31.0	36.0	5.0	.05
15.5	24.5	9.0	.02	36.0	40.5	4.5	.09

TABLE 3. - Core-sample analyses, Big Ben molybdenum deposit (Cont'd.)

Interval, feet		Sample length,	Molybdenum,	Interval, feet		Sample length,	Molybdenum,
From-	To-	feet	percent	From-	To-	feet	percent
40.0	44.5	4.0	0.20	154.5	158.5	4.0	0.21
44.5	48.5	4.0	.08	158.5	163.0	4.5	.12
48.5	53.5	5.0	.04	163.0	167.5	4.5	.15
53.5	58.5	5.0	.12	167.5	174.0	6.5	.14
58.5	63.0	4.5	.16	174.0	179.0	5.0	.12
63.0	68.0	5.0	.15	179.0	183.0	4.0	.13
68.0	72.5	4.5	.11	183.0	188.0	5.0	.26
72.5	76.5	4.0	.10	188.0	193.0	5.0	.13
76.5	81.5	5.0	.06	193.0	197.5	4.5	.14
81.5	86.5	5.0	.09	197.5	204.5	7.0	.15
86.5	91.5	5.0	.06	204.5	213.5	9.0	.04
91.5	96.5	5.0	.09	213.5	220.5	7.0	.01
96.5	101.5	5.0	.07	220.5	225.5	5.0	.02
101.5	106.0	4.5	.08	225.5	230.5	5.0	.20
106.0	113.5	7.5	.04	230.5	235.5	5.0	.16
113.5	117.0	3.5	.07	235.5	240.5	5.0	.17
117.0	120.0	3.0	.18	240.5	243.5	3.0	.24
120.0	128.0	8.0	.16	243.5	248.0	4.5	.23
128.0	134.5	6.5	.13	248.0	255.0	7.0	.19
134.5	139.5	5.0	.11	255.0	259.5	4.5	.19
139.5	144.0	4.5	.08	259.5	267.0	7.5	.13
144.0	149.5	5.5	.14	267.0	271.0	4.0	.14
149.5	154.5	5.0	.11				
Total						271.0	

Weighted average, 0.113 percent Mo.
Weighted average, 0.188 percent MoS_2.

Channel Sampling

The entire length of the Big Ben lower adit was channel-sampled in 5-foot sections; 8 pounds of material was obtained per foot sampled (fig. 3). The channel sample analyses are given in the following table:

TABLE 4. - Analyses of channel samples from lower adit, Big Ben molybdenum deposit

Interval, feet		Sample length,	Molybdenum,	Interval, feet		Sample length,	Molybdenum,
From-	To-	feet	percent	From-	To-	feet	percent
Portal	10.0	-	-	40.0	45.0	5.0	0.14
10.0	15.0	5.0	0.11	45.0	50.0	5.0	.14
15.0	20.0	5.0	.14	50.0	55.0	5.0	.17
20.0	25.0	5.0	.10	55.0	60.0	5.0	.16
25.0	30.0	5.0	.18	60.0	65.0	5.0	.16
30.0	35.0	5.0	.23	65.0	70.0	5.0	.10
35.0	40.0	5.0	.28	70.0	75.0	5.0	.13

TABLE 4. - Analyses of channel samples from lower adit, Big Ben molybdenum deposit (Cont'd.)

Interval, feet From-	To-	Sample length, feet	Molybdenum, percent	Interval, feet From-	To-	Sample length, feet	Molybdenum, percent
75.0	80.0	5.0	0.17	205.0	210.0	5.0	0.08
80.0	85.0	5.0	.13	210.0	215.0	5.0	.10
85.0	90.0	5.0	.17	215.0	220.0	5.0	.02
90.0	95.0	5.0	.11	220.0	225.0	5.0	.02
95.0	100.0	5.0	.17	225.0	230.0	5.0	.06
100.0	105.0	5.0	.32	230.0	235.0	5.0	.03
105.0	110.0	5.0	.30	235.0	240.0	5.0	.01
110.0	115.0	5.0	.10	240.0	245.0	5.0	.06
115.0	120.0	5.0	.14	245.0	250.0	5.0	.09
120.0	125.0	5.0	.11	250.0	255.0	5.0	.10
125.0	130.0	5.0	.17	255.0	260.0	5.0	.12
130.0	135.0	5.0	.11	260.0	265.0	5.0	.19
135.0	140.0	5.0	.20	265.0	270.0	5.0	.12
140.0	145.0	5.0	.15	270.0	275.0	5.0	.07
145.0	150.0	5.0	.08	280.0	285.0	5.0	.10
150.0	155.0	5.0	.17	285.0	290.0	5.0	.10
155.0	160.0	5.0	.11	290.0	295.0	5.0	.07
160.0	165.0	5.0	.09	295.0	300.0	5.0	.11
165.0	170.0	5.0	.11	300.0	305.0	5.0	.10
170.0	175.0	5.0	.17	305.0	310.0	5.0	.11
175.0	180.0	5.0	.10	Total		295.0	
180.0	185.0	5.0	.20	Weighted average, 0.129 percent Mo.			
185.0	190.0	5.0	.11	Weighted average, 0.215 percent MoS_2.			
190.0	195.0	5.0	.11	Upper adit			
195.0	200.0	5.0	.10	Sample across vein			
200.0	205.0	5.0	.09	near face		4.0	0.45

Metallurgical Testing

A representative composite sample made up of core-sample rejects was sent to the Bureau of Mines laboratory at Salt Lake City, Utah, for beneficiation tests. The final results of these tests are summarized as follows:

Chemical analyses of representative sample, percent

MoS_2	MoO_3	Pb	Cu	Ox.Cu	Fe	WO_3	S	SiO_2	Insol.	Al_2O_3	MgO	CaO	Zn.	Ag
0.25	1/0.01	1/0.05	0.03	0.01	1.15	Nil	0.35	67.2	91.0	14.5	1.45	1.2	Nil	Tr.

1/ Less than.

This sample was ground to 98 percent minus 65-mesh and treated by selective flotation. A soda-ash circuit with fuel oil as a collector and a higher alcohol frother (B-23) produced a roughing recovery of 87 percent of the molybdenite and a rejection of over 99 percent of the weight. The rougher concentrates were reground in a pebble mill and subjected to three stages of cleaning. Potassium dichromate, sodium cyanide, and sodium silicate for the depression of lead and copper were used in the cleaning circuits. Small additions of frother were employed as needed. The final cleaned concentrate assayed 88.9 percent molybdenite, 0.05 percent lead, 0.06 percent copper, 0.017 percent phosphorus, and 3.6 percent insoluble. The concentrate contained 0.18 percent of the original sample weight and represented a recovery of over 77 percent of the molybdenite. By combining the last cleaner tailing with the final concentrate, the over-all recovery was raised to 81.6 percent, but the grade of the concentrate was lowered to 84 percent molybdenite, 0.2 percent lead, and 0.09 percent copper. The ratio of concentration was 544 for the final concentrate or 501 for the combined final tailing and concentrate.

Although the lead content within the mineralized area investigated is generally low (less than 0.1 percent), special samples indicate some variation in the molybdenite:galena ratio. A small increase in lead content introduces metallurgical complications, as demonstrated by the following summarized results on a special sample taken from the lower Big Ben adit:

Chemical analyses of special high-lead sample, percent

MoS_2	Pb	Cu	Zn	Fe	WO_3	S	SiO_2	Al_2O_3	CaO	Insol.
0.27	0.22	1/0.05	Nil	1.25	Nil	0.8	67.0	14.7	0.08	92.0

1/ Less than.

This special sample was ground to 75 percent minus 200-mesh and treated by flotation. Approximately 59 percent of the molybdenite was recovered in a final concentrate containing 81.5 percent molybdenite, 0.3 percent lead, 0.4 percent iron, and 10.8 percent insoluble. In another test on the same sample ground to minus 100-mesh, 80.4 percent of the molybdenite was recovered in a concentrate containing 55.0 percent molybdenite, 15.6 percent lead, 0.8 percent iron, and 15.6 percent insoluble.

The above tests on the special sample indicate that when more than 0.1 percent lead was present, fine grinding would be required to effect the separation of galena and molybdenite. However, such fine grinding causes a material decrease in molybdenite recovery.

Detailed data on the metallurgical tests are given in the appendix.

APPENDIX

A. - Bureau of Mines Drill-Hole Logs7/

Hole 1

Location: N. 21,984, E. 14,289 — Bearing: S. 26° E.
Altitude at collar: 5,903 feet — Inclination: -15°

Interval, feet		
From-	To-	Description
0	45	Snow Creek quartz porphyry: Visible molybdenite starts at 5 ft. Irregular quartz seams less than 1/2 inch are common. Molybdenite in quartz seams at 30° to 60° and disseminated in rock. Iron oxide common in fractures to 24 ft. At 32 ft., 2 in. brecciated band with pyrite at 60 degrees. Contact at 45 ft. brecciated.
45	46	Pinto diorite: Feldspars kaolinized.
46	65	Quartz porphyry: Barren quartz seams at 60°. Disseminated molybdenite. At 59 ft., fault gouge with slickensided molybdenite at 55°.
65	75	Pinto diorite: Disseminated molybdenite.
75	158-1/2	Quartz porphyry: At 82 ft. vug parallel to core. At 84 ft. epidote along fractures at 30°-60°. From 102-103 ft. strong silicification and from 110-118 general silicification. At 117 ft., 1 in., molybdenite-pyrite seam at 60°. In general, molybdenite in seams at about 60° and disseminated in rock.
158-1/2	165	Pinto diorite: At 159-1/2, high-grade molybdenite seams at 40°.
165	167-1/2	Quartz porphyry.
167-1/2	170	Pinto diorite.
170	176	Quartz porphyry: Molybdenite in fractures at 55°.
176	178	Mixed zone of quartz porphyry and diorite.
178	182	Diorite.
182	185	Quartz porphyry: At 183 ft., silicified and vuggy. At 185 ft., fault gouge at 90°. Barren quartz stringers at 90°. Molybdenite stringers at 80°. Molybdenite disseminated in rock.
185	186-1/2	Diorite: Disseminated molybdenite.
186-1/2	188-1/2	Quartz porphyry: Disseminated molybdenite.
188-1/2	192-1/2	Diorite: Molybdenite seams and barren quartz stringers at 10°.
192-1/2	223	Quartz porphyry: At 194-1/2 ft., 1/2 in. molybdenite-chalcopyrite-quartz seam. At 200 ft., strong molybdenite seam at 15°. At 215-220 ft. brecciated, strong molybdenite. Also open fractures with pyrite, molybdenite and galena crystals. At 223 ft., brecciated and mineralized with molybdenite.
223	228	Diorite: Barren quartz seams and molybdenite seams at 60°.
228	229	Quartz porphyry.
229	233	Diorite: Barren quartz seams common.

7/ As logged by J. J. Collins, S. C. Creasey, and E. A. Scholtz, Geological Survey. All angles stated in logs were measured from the core.

Interval, feet		
From-	To-	Description
233	235	Biotite schist.
235	237-1/2	Mixed zone of diorite and quartz porphyry (?)
237-1/2	249	Biotite gneiss: At 245 ft., molybdenite seams at 65°. At 247 ft., disseminated molybdenite.
249	253	Diorite: At 249-1/2 ft., strong molybdenite seam at 35°.
253	259	Biotite gneiss.
259	279	Diorite: Quartz and molybdenite seams at various attitudes.
279	326	Granite porphyry: Trace of molybdenite and pyrite only. Galena crystal in vug at 314 feet.
326	338	Biotite gneiss: Small quartz seams. Molybdenite seams at 10°.
338	340	Diorite.

Hole 3

Location: N. 21,982, E. 14, 113 Bearing: S. 26° E.
Altitude at collar: 5,887 feet Inclination: -30°

Interval, feet		
From-	To-	Description
0	7	Overburden.
7	13	Quartz porphyry: No molybdenite visible.
13	33-1/2	Diorite: First visible molybdenite at 30 feet. At 33-1/2 feet, molybdenite along contact.
33-1/2	34-1/2	Quartz porphyry (?)
34-1/2	41	Diorite.
41	42-1/2	Transition zone: Molybdenite seams at 40°.
42-1/2	45	Quartz porphyry: Molybdenite seams and quartz seams at about 35°.
45	46	Siliceous transition zone.
46	54	Quartz porphyry: Molybdenite seams at 20°-45°. At 51 feet, pyrite seam at 20°.
54	55	Diorite.
55	74	Quartz porphyry: Molybdenite in seams and disseminated in rock.
74	84	Diorite: Few small dikes of quartz porphyry. At 76, 82, and 84 feet, quartz seams at 45°.
84	87	Diorite.
87	88	Biotite gneiss.
88	89-1/2	Diorite: At 89-1/2 feet, open fractures with molybdenite and pyrite at 90°.
89-1/2	98	Quartz prophyry: Molybdenite and molybdenite-quartz seams.
98	106	Diorite.
106	107	Biotite gneiss.
107	107-1/2	Quartz porphyry: Molybdenite seams at 50°.
107-1/2	111	Biotite gneiss: Molybdenite seams at 50°
111	112	Quartz porphyry.
112	115	Biotite gneiss.

Interval, feet		Description
From-	To-	
115	118	Quartz porphyry.
118.	119	Biotite gneiss: Fault gouge containing slickensided molybdenite at 58°.
119	121	Diorite.
121	128-1/2	Biotite gneiss: Good molybdenite in quartz seams. Disseminated molybdenite in rock.
128-1/2	132	Diorite.
132	160	Biotite gneiss: Molybdenite-quartz seams at 60°. Disseminated molybdenite. At 157 feet, galena, sphalerite, pyrite, fluorite, and quartz along open fracture at 55°. Little dosseminated pyrite.
160	162	Quartz porphyry: Molybdenite in seams at 45°.
162	169	Biotite gneiss: At 164 feet, molybdenite-quartz stringers. Alternating silicified zones containing molybdenite and barren biotite rock.
169	171	Diorite: At 171 feet, slickensided molybdenite in fault gouge at 65°.
171	188.5	Biotite gneiss: At 174 feet, 1 foot of diorite. Silicified zones about 6 inches wide containing molybdenite at 171, 172, and 181-1/2 feet. At 184 feet, gouge with molybdenite at 55°. Disseminated molybdenite.
188.5	190	Diorite: At 190 feet, quartz seams with a little molybdenite at 35°.
190	200.5	Biotite gneiss: Molybdenite-quartz seams and molybdenite seams. Little disseminated molybdenite. Silicified from 196-200-1/2 feet.
200.5	207	Diorite: Silicified, good molybdenite seams.
207	216-1/2	Quartz porphyry: Silicified, good molybdenite seams.
216-1/2	218	Diorite.
218	223	Quartz porphyry: Inclusions of biotite rock at 219-220 feet. Strong pyrite seams at 223 feet at 90°. Good molybdenite in seams and disseminated in rock.
223	230	Diorite: Molybdenite seams at 40°. Few quartz seams. Disseminated molybdenite.
230	266-1/2	Quartz porphyry: Molybdenite in seams and disseminated. At 258 feet, fault gouge at 40°.
266-1/2	270-1/2	Biotite gneiss: Few quartz seams. Little disseminated molybdenite.
270-1/2	289-1/2	Quartz porphyry: Molybdenite in seams and disseminated. Quartz seams at 281 feet.
289-1/2	291-1/2	Biotite gneiss.
291-1/2	294	Quartz porphyry: Strong molybdenite mineralization.
294	298	Biotite gneiss.
298	300	Quartz porphyry: Strong molybdenite mineralization.
300	303	Biotite gneiss.
303	308	Quartz porphyry: Molybdenite in seams. Trace of galena at 306 feet.
308	311	Diorite: Molybdenite in seams.
311	328-1/2	Quartz porphyry: Molybdenite in seams and disseminated in rock. Quartz seams at 320 feet.

Interval, feet		
From-	To-	Description
328-1/2	332	Diorite: Kaolinized. Molybdenite in seams at 40°.
332	334	Quartz porphyry: Silicified.
334	347	Diorite.
347	350-1/2	Quartz porphyry.
350-1/2	351-1/2	Diorite: Kaolinized. Brecciated contact at 350-1/2 feet.
351-1/2	353-1/2	Quartz porphyry: Fault contact at 353-1/2 feet with slickensided molybdenite.
353-1/2	357-1/2	Diorite: Strong molybdenite in seams and disseminated in rock.
357-1/2	369-1/2	Quartz porphyry: Well-silicified. Strong molybdenite in seams and disseminated in the rock.
369-1/2	392-1/2	Diorite: Feldspars kaolinized to 374 feet. Silicified diorite from 374-392 feet. Stronger molybdenite in silicified zone. At 386 feet, gouge with slickensided molybdenite at 30°.
392-1/2	394-1/2	Biotite gneiss.
394-1/2	396	Quartz porphyry.
396	399	Diorite: At 398 feet, gouge containing slickensided molybdenite at 50°.
399	400	Quartz porphyry.
400	411	Diorite: Molybdenite-quartz seams and molybdenite seams at 45°-70°.
411	412	Quartz porphyry.
412	424	Diorite: Feldspars slightly kaolinized.

Hole 4

Location: N. 21,799, E. 14,044
Altitude at collar: 5,968 feet

Bearing: S. 26° E.
Inclination: -30°

Interval, feet		
From-	To-	Description
0	4-1/2	Overburden and a little quartz porphyry.
4-1/2	34	Biotite gneiss: Trace of molybdenite. Few quartz seams.
34	85	Diorite: At 58 feet, few molybdenite-quartz seams at 50°-75°. At 83 feet, a 6-inch molybdenite-quartz vein at 80°. A little molybdenite in seams and disseminated. Molybdite around 35 feet.
85	96-1/2	Quartz porphyry: End of iron oxide at 92 feet. Strong molybdenite in seams and disseminated in the rock.
96-1/2	104	Diorite.
104	117	Biotite gneiss: Quartz seams with little molybdenite at 75°. Few molybdenite seams at 30°-50°. Little disseminated molybdenite. Trace of fluorite at 114 feet.
117	129-1/2	Quartz porphyry: Molybdenite quartz seams at 35°. Disseminated molybdenite. Trace of fluorite at 124 feet.
129-1/2	134	Diorite: Contact at 134 feet silicified with a little disseminated molybdenite.
134	152	Quartz porphyry: Molybdenite-quartz seams and disseminated molybdenite.

Interval, feet		
From-	To-	Description
152	169	Diorite: Molybdenite-quartz seams and molybdenite seams. Pyrite.
169	170	Quartz porphyry.
170	179	Diorite: At 174 feet, 3-inch silicified, brecciated zone with molybdenite and pyrite.
179	182	Quartz porphyry: Silicified.
182	204	Diorite: Trace of fluorite at 193 feet. At 195-200 feet, molybdenite in seams. A little disseminated molybdenite.
204	212-1/2	Biotite gneiss: Molybdenite in seams at 35°.
212-1/2	214	Quartz porphyry.
214	285-1/2	Biotite gneiss: Molybdenite in seams and in quartz seams at 25°-75°. Trace of fluorite at 276 and 286 feet. A little disseminated molybdenite.
285-1/2	299	Quartz porphyry: A little molybdenite in seams and disseminated in the rock.
299	309	Biotite gneiss.
309	315-1/2	Quartz porphyry. Molybdenite mineralization not strong.
315-1/2	329-1/2	Biotite gneiss: A few molybdenite-quartz seams and molybdenite seams. A little disseminated molybdenite.
329-1/2	340	Diorite: Molybdenite seams. At 335 feet, a brecciated quartzose zone with strong molybdenite.
340	348	Biotite gneiss: A few molybdenite seams at 35°.
348	350	Diorite.

Hole 5

Location: N. 22,061, E. 14,409 — Bearing: S. 44° E.
Altitude at collar: 5,985 feet — Inclination: -30°

Interval, feet		
From-	To-	Description
0	126	Quartz prophyry: Molybdenite-quartz seams and molybdenite seams at 20°-60°. A little disseminated molybdenite. Visible molybdenite starts at 38 feet. A trace of molybdenite at 74 feet.
126	133-1/2	Diorite: Two small quartz porphyry dikes at 128 and 131 feet. Molybdenite mineralization weak.
133-1/2	158	Quartz porphyry: A little molybdenite in seams and disseminated.
158	207	Diorite: A little molybdenite in seams. Only a trace disseminated in the rock. Strong molybdenite and pyrite at 161 feet.
207	227	Granite porphyry: Only a trace of molybdenite.
227	271	Diorite: Many small diklets of dense quartz porphyry. Molybdenite in seams at 40°-70°. A little disseminated molybdenite.

B. - Metallurgical Test Data

Source of Sample. Big Ben molybdenum deposit, Neihart district, Cascade County, Mont. Representative sample made up from diamond-drill core-sample rejects.

Physical Character. Flakes of molybdenite and small amounts of galena, chalcopyrite, and pyrite in a gangue of quartz, quartz porphyry, diorite, and schist.

Chemical Character.

Assay, percent														
MoS_2	MoO_3	Pb	Cu	Ox.Cu	Fe	WO_3	S	SiO_2	Insol.	Al_2O_3	MgO	CaO	Zn
0.25	1/0.01	1/0.05	0.03	0.01	1.15	Nil	0.35	67.2	91.0	14.5	1.45	1.2	Nil

1/ Less than.

Test: Z-15189, preliminary flotation: representative sample.

Treatment. Ground 15 minutes in ball mill.
Bulk flotation.
Recleaning of concentrates.

Metallurgical Data.

Product	Weight, grams	Weight, percent	Assay, percent					Distribution, percent	
			MoS_2	Pb	Cu	Insol.	P	MoS_2	Insol.
MoS_2 conct. ...	7.16	0.18	79.3	1.20	0.20	12.2	-	61.8	0.1
Cl. tailing	38.00	.98	5.18	.50	.17	78.4	-	25.4	.8
Ro. tailing	3840.00	98.84	.05	.05	.02	91.4	-	12.8	99.1
Calc. head	3885.16	100.00	.215	1/ .05	.022	91.1		100.0	100.0

1/ Less than.

Reagents used.

	Time	Pound per ton of ore						
		Fuel oil	Pine oil	Na_2CO_3	H_2SO_4	$K_2Cr_2O_7$	Na_2SiO_3	pH
Grind	15'	0.28		4.0	-	-	-	-
Rougher .		-	0.16					-
Cleaner ...	-	-	-	-	0.05	0.25	0.7	5.0

Test: Z-15190, preliminary selective flotation, representative sample.

Treatment. Ground in ball mill.
Bulk flotation.
Rougher concentrates reground in pebble mill.
Selective flotation and recleaning of concentrates.

Metallurgical Data.

Product	Weight, grams	Weight, percent	Assay, percent				Distribution, percent	
			MoS_2	Pb	Cu	Insol.	MoS_2	Insol.
MoS_2 conct.	25.2	0.21	82.95	0.05	0.20	15.8	75.3	-
Cl. tails..	93.0	.78	3.62	1.0	.10	84.2	12.1	0.8
Ro. tails..	11870.0	99.01	.03	.05	.01	91.0	12.6	99.2
Calc. head.	11988.2	100.00	.23	.06	.01	90.8	100.0	100.0

Reagents used.

	Time	Pound per ton of ore						
		Fuel oil	Frother 1/	Na_2CO_3	H_2SO_4	$K_2Cr_2O_7$	pH
Grind	11'	0.20	-	-	-	-	-
Rougher	-	-	0.22		-		-
Regrind	20'	-	-	-	-	-	
Cleaner 1	-	-	-	-	0.30	0.16	3.0
Cleaner 2	5'	-	.13	0.33	-	-	-

1/ Frother: 50 - 50 mixture of cresylic acid and pentasol alcohol.

Remarks. The two cleaner tailings were combined for assay. Rougher concentrates were reground in pebble mill for 20 minutes before cleaning. Screen analysis of rougher tailings gave 4.11 percent on 65-mesh, 11.36 percent on 100-mesh, 33.88 percent on 200-mesh, and 50.85 percent minus 200-mesh.

Test: Z-15192, preliminary selective flotation, representative sample.

Treatment. Ground in ball mill.
Bulk flotation.
Rougher concentrates reground in pebble mill.
Selective flotation.
Cleaner concentrates reground in pebble mill.
Recleaning of concentrates.

Product	Weight, grams	Weight, percent	Assay, percent				Oz./T	Distribution, percent	
			MoS_2	Pb	Cu	Insol.	Ag	MoS_2	Insol.
MoS_2 conct. 1	24.1	0.20	85.85	1.80	0.25	6.4	0.9	76.8	1/0.1
MoS_2 conct. 2	3.6	.03	43.40	6.90	.47	31.0	-	5.8	1/0.1
Cl. tail. 2..	20.0	.17	3.60	2.10	.10	79.4	.6	2.7	.1
Cl. tail. 1..	180.0	1.50	.53	.05	.04	87.2	Tr.	3.6	1.5
Ro. tail.....	11780.0	98.10	.025	.05	1/.02	87.4	Tr.	11.1	98.4
Calc. head ..	12007.7	100.00	0.22	-	0.02	87.2	Tr.	100.0	100.0
Comb. concts.	-	0.23	79.0	2.5	0.28	9.6	-	82.6	

1/ Less than.

Reagents used.

	Time	Fuel oil	Pound per ton of ore					
			Frother 1/	Na_2CO_3	H_2SO_4	$K_2Cr_2O_7$	Na_2SiO_3	pH
Grind.....	15'	0.24	-	-	-	-	-	-
Rougher...	-		0.22				-	
Regrind...			-		-	-		-
Cl. No. 1.			.01	0.33	-			-
Cl. No. 2.	-	-	.01	-	0.05	0.04	1.17	7.0

1/ Frother: 50-50 mixture of cresylic acid and pentasol alcohol.

Remarks. Screen analysis of the rougher tailings gave 1.35 percent on 65-mesh, 7.24 percent on 100-mesh, 26.34 percent on 200-mesh, and 65.07 percent minus 200-mesh.

Test: Z-15196, final selective flotation, representative sample.

Treatment. Ground in ball mill to 98 percent minus 65-mesh.
Bulk flotation.
Rougher concentrates reground in pebble mill.
Selective flotation of concentrates.
Regrinding and recleaning of concentrates.

Product	Weight, grams	Weight, percent	Assay, percent					Distribution, percent	
			MoS_2	Pb	Cu	Insol.	P	MoS_2	Insol.
MoS_2 conct.	16.6	0.18	88.90	1/0.05	0.06	3.6	0.017	77.7	1/0.1
Cl. tail. 3	1.4	.02	38.75	1.70	.40	-		3.9	
Cl. tail. 2	2.0	.02	16.50	14.10	1.42	-		1.5	
Cl. tail. 1	46.0	.51	2.00	.05	.05	64.8		4.8	-
Ro. tail...	8956.7	99.27	.025	1/.05	.01	91.6	-	12.1	99.6
Calc. head.	9022.7	100.00	0.21	1/0.05	0.01	91.5	-	100.0	100.0
Comb. MoS_2 conc. and Cl. tail. 1	18.0	0.20	84.00	0.20	0.094	-		81.6	-

1/ Less than.

Reagents used.

	Time	Pound per ton of ore						
		Fuel oil	Na_2CO_3	B-23	$K_2Cr_2O_7$	NaCN	Na_2SiO_3	pH
Grind	15'	0.28	-	-	-	-	-	-
Rougher	-	-	-	0.08	-			
Regrind	20'		1.0			-	0.3	-
Cleaner 1				0.001	-	-		10.0
Regrind			-		-			-
Cleaner 2	-	-	-	-	0.1	0.1	.6	9.5
Cleaner 3 ...	-	-	.4	.002		-	-	-

Remarks. It appears from this test that B-23 is definitely a better frother than the cresylic acid-pentasol alcohol mixture. A cleaner and more stable froth was obtained.

Potassium dichromate used with sodium cyanide at a high pH was effective in reducing the lead and copper content of the MoS_2 concentrate.

Special Metallurgical Sample-High Lead

Source of Sample. Big Ben molybdenum deposit, Neihart district, Cascade County, Mont. Special bulk sample from lower Big Ben adit. Not representative of explored area.

Physical Character. Flakes of molybdenite, above average amounts of galena and some pyrite and chalcopyrite in a gangue of quartz and quartz porphyry.

Chemical Character.

Assay, percent											
MoS_2	Pb	Cu	Zn	Fe	WO_3	S	SiO_2	Al_2O_3	CaO	Insol.	Ag
0.27	0.22	1/0.05	Nil	1.25	Nil	0.08	67.0	14.7	0.08	92.0	Tr.

1/ Less than.

Test: Z-15067, Selective flotation of special high-lead sample.

Treatment. Ground in ball mill to 75 percent minus 200-mesh.
Bulk flotation.
Selective flotation of concentrate.
Regrinding and recleaning of concentrate.

Metallurgical Data.

Product	Weight, grams	Weight, percent	Assay, percent				Distribution, percent			
			MoS_2	Fe	Pb	Insol.	MoS_2	Fe	Pb	Insol.
Ro. tail.	15452.00	98.89	0.025	1.10	0.12	92.1	11.7	95.3	64.4	99.4
Cl. tail.	116.00	.74	4.40	9.40	1.95	63.4	15.1	2.9	8.0	.5
Fe recl. tail.	22.00	.14	14.45	13.40	13.15	29.2	9.5	1.7	10.0	.1
Pb recl. tail.	7.80	.05	8.05	1.00	53.50	21.8	1.9	.1	14.5	-
Final recl. concentrate	24.35	.16	81.50	.40	.30	10.8	58.9		.3	
Final recl. tailing ...	3.86	.02	25.35	1.70	19.60	40.4	2.9	-	2.8	-
Calculated head	15626.01	100.00	.22	1.14	.18	91.6	100.0	100.0	100.0	100.0

Reagents used.

	Time	Pound per ton of ore							
	min.	Fuel oil	Frother1/	CaO	NaCN	Na_2SiO_3	$K_2Cr_2O_7$	H_2SO_4	pH
Grind	25	0.200	-	-	-	-	-	-	-
Rougher		.025	0.200	-		-	-	-	-
Cleaner		.003	.003	0.062		0.050	0.025	-	9.8
Fe recleaner ..	5	-		.125	0.038	-		-	11.6
Pb recleaner			.025	-		.005	.012	0.025	6.3
Regrind		-	-			-		-	-
Final recleaner		.025	.012	-	-	.005	-	-	-

1/ Frother: 50-50 mixture of cresylic acid and pentasol alcohol.