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Bureau of Mines  
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EXPLORATION, DEVELOPMENT, AND COSTS  
OF THE STORMY DAY TUNGSTEN MINE,  
PERSHING COUNTY, NEV.

BY A. C. JOHNSON

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UNITED STATES DEPARTMENT OF THE INTERIOR  
Fred A. Seaton, Secretary  
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# EXPLORATION, DEVELOPMENT, AND COSTS OF THE STORMY DAY TUNGSTEN MINE, PERSHING COUNTY, NEV.<sup>1/</sup>

by

A. C. Johnson<sup>2/</sup>

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## SUMMARY

This report describes exploration, development, and exploitation methods, and summarizes costs at the Stormy Day mine, which was discovered in 1941. Several shipments of tungsten ore were made in 1944 to the Metals Reserve Company, Salt Lake City, Utah. The purchase of tungsten by the Federal Government, which began in 1951, stimulated interest in tungsten, and a successful program of exploration with participation of the Defense Minerals Exploration Administration (DMEA) indicated enough ore to warrant development of the property. Development work comprised drifting, crosscutting, and raising. Shrinkage stoping was used for mining the ore. Operations were suspended in October 1956, when the Federal Government terminated its purchase program. Total production of the mine was approximately 20,000 tons of tungsten ore.

## INTRODUCTION

This information circular is one of a series, prepared in cooperation with various mining companies and published by the Bureau of Mines, relating to methods and costs of equipping and developing mining properties in the United States.

The Stormy Day mine is in the Hooker mining district, on the west side of the Selenite Range, Pershing County, Nev., about 87 miles north of Reno and 18 miles southeast of Gerlach, Nev., a town on the Western Pacific Railroad and Nevada State Highway 34. (See fig. 1.)

Several deposits of scheelite occur in the Granite Range, which extends northward from Gerlach, and in the Selenite Range southeast of Gerlach. The main mass of both ranges is a granitic intrusive. Irregular bodies of tactite occur along a northerly trending and westerly dipping contact-metamorphic zone between granite and marbleized limestone. Exploration of the Stormy Day mining claims indicated that part of the tactite contained enough scheelite to form ore bodies of commercial grade.

## ACKNOWLEDGMENTS

Acknowledgment is made to Dr. Fred M. Anderson, to the law firm of Bible and McDonald (Reno, Nev.), and to Dr. A. J. Dingacci (Fallon, Nev.) for permission to publish this paper. Special acknowledgment is made to John H. Uhalde, Reno, Nev., superintendent of the Stormy Day mine, for information on the exploration, development, and mining methods used at the property.

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<sup>1/</sup> Work on manuscript completed May 1958.

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## HISTORY

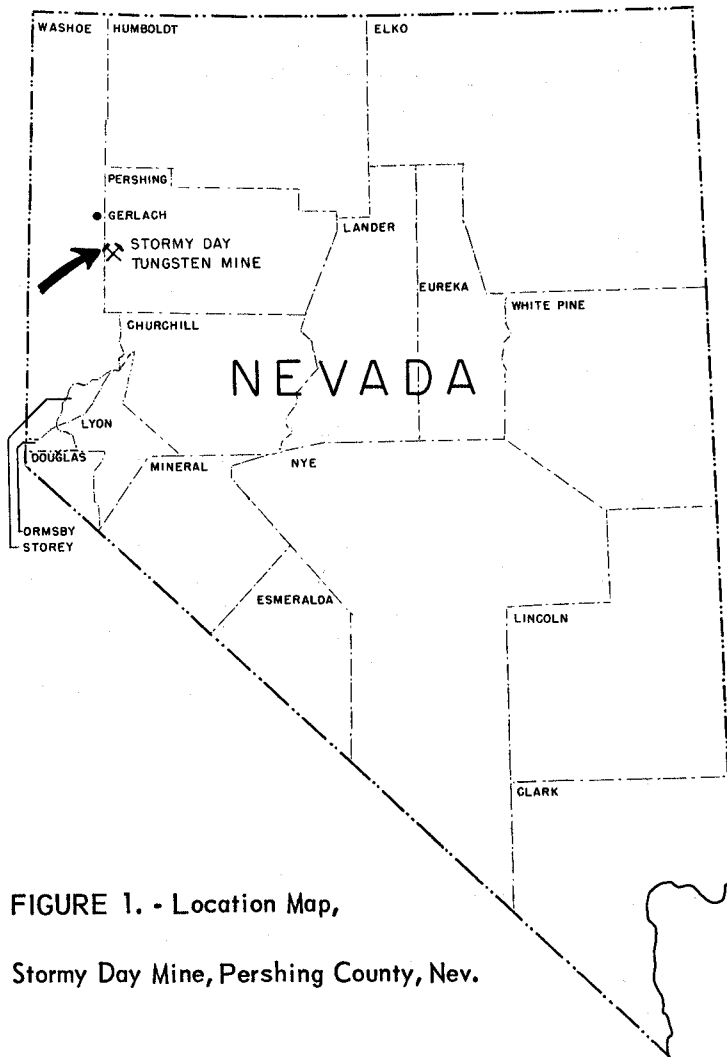


FIGURE 1. - Location Map,  
Stormy Day Mine, Pershing County, Nev.

The Stormy Day mining claims were first located by J. J. Thrasher, Helen Thrasher, and Abel Azellano of Gerlach, Nev., in 1941 and 1942 and were leased to George B. Thatcher, William Woodburn, and George E. Turpin of Reno, Nev. in 1942 and 1943. Two loans, obtained from the Reconstruction Finance Corporation, were used for cross-cutting to the main ore body at an average depth of about 135 feet below the outcrop, raising, stoping, and sinking a 60-foot winze.

Early in 1944, the owners took possession of the property and shipped several lots of ore to the Metals Reserve Company, Salt Lake City, Utah. Shipments stopped on July 12, 1944, when the premium price on tungsten dropped from \$30 to \$24 per short-ton unit of tungsten trioxide ( $WO_3$ ). The property remained idle until 1951, when it was leased to Mayfield and Reed of Los Angeles, Calif., who mined and shipped some ore. In 1951 and 1952, the No. 11 crosscut adit was driven 236 feet by Mayfield and Reed.

In 1953 Stanley F. O'Leary obtained a lease and option on the property from J. J. Thrasher. O'Leary applied for and was granted a contract dated May 14, 1953, from the DMEA. Under the terms of the contract, he was permitted to trench by bulldozer along the surface tactite exposure for about 500 feet south of the No. 2 adit and to extend the No. 11 adit 200 feet to the intersection with the granite footwall of the mineralized zone, then drift south from the crosscut adit not more than 180 feet. An amendment to the contract provided for 1,000 feet of diamond drilling to determine the vertical and lateral extent of the mineralized tactite. The DMEA provided 75 percent and the operator 25 percent of the funds. O'Leary sold a one-third interest in his lease and option to Dr. Fred M. Anderson of Reno, Nev., to help finance his part of the exploration. Shortly after the DMEA approved the loan, O'Leary died. Dr. Fred M. Anderson, Alan Bible, Robert L. McDonald, and Dr. A. J. Dingacci formed a partnership, exercised the O'Leary option, and bought the Stormy Day mine.

Exploration work on the property comprised bulldozer trenching, crosscutting, drifting, and diamond drilling. A combination dormitory and cookhouse also was built to accomodate employees of the mine.

In August 1954 the property was leased to Modoc Mines & Exploration Co. This lease and option terminated in September 1954. From September 1954 until early summer of 1955, development work was continued at the property by the owners. The DMEA contract was successfully completed May 11, 1955. A lease with option to purchase was then given to Nev-Tah Oil & Mining Co., a Utah corporation. This lease and option terminated in September 1955.

Mining operations were resumed by the owners in September 1955, and arrangements were made to mill the ore at the Toulon mill near Lovelock, Nev. Approximately 15,000 tons of ore was milled at the Toulon mill and the concentrate sold to the General Services Administration (GSA).

A lease with option to purchase the property was obtained by Malcolm Gould, Ira Joralemon, Peter Joralemon, Rodgers Peale, and Frank Dowling, all of San Francisco, Calif., in October 1956. The lessees did no work on the property, and the lease was terminated.

The property was sold to Robert N. Avery, Hillsborough, Calif., on May 27, 1957.

#### PRODUCTION

In 1944, 1,200 tons of tungsten ore was shipped to the Metals Reserve Company, Salt Lake City, Utah. In 1951 and 1952, 900 tons of ore was mined and shipped to the Toulon mill near Lovelock, Nev., and the Alpine mill near Gardnerville, Nev. From 1953 through 1956, 17,850 tons of ore was mined; 15,000 tons was shipped to the Toulon mill and 2,850 tons to the United States Vanadium plant (Bishop, Calif.), the Gatchell mill (Redhouse, Nev.), the Union Lead Co. mill (approximately 10 miles south of Reno, Nev.), and the Janey mill (near Gabbs, Nev.).

#### DESCRIPTION OF DEPOSIT

The Stormy Day mining claims are at an elevation of 5,000 to 6,000 feet in a mile-wide desert foothill belt of low-to-moderate relief. The formation is eroded in a steeply tilted sequence of limy sedimentary rocks and volcanic cap rocks that lie west of a rugged, mountainous terrain.

The core of the Selenite Range is a granodioritic batholith. The contact between this igneous body and the invaded calcareous sedimentary formation has, in places, formed tactite that is mineralized with scheelite. The strike of the contact is nearly north-south along the western foothills of the range for about 4 or 5 miles. The principal sedimentary rock invaded by the granodiorite is a thin-bedded, shaly limestone several hundred feet thick, with intercalated, thicker bedded, purer limestone members. In a broad sense, the intrusive relations are structurally concordant, as the sedimentary rocks generally were noted to have a north-south strike and a 50° to 70° westerly dip paralleling the contact.

Along the contact, between the marbelized limestone and granite, bodies of tactite occur, part of which are mineralized with scheelite. The scheelite-bearing tactite generally is a coarse-grained aggregate of garnet, epidote, pyroxene, quartz, pyrrhotite, pyrite, molybdenite, and chalcopyrite. Other zones of coarse tactite and fine-grained, pale, calc-silicate hornfels contain little or no scheelite.



An outline of known dimensions of the deposit, as exposed by underground workings at the mine, follows.

The contact has been developed with 300 feet of drifts 105 and 125 feet below the surface and about 390 feet on the No. 11 adit level. Three ore shoots, each 50 to 70 feet long, occurring along the strike of the contact and dipping 50° to 60° to the west, extend from the lower to the upper level. The central ore shoot is fully developed, and the other two are partly developed. Above the 105- and 125-foot level, the two southern ore shoots join to form a wider, thicker, flatter dipping, single ore body that has been exposed to the surface. The northern ore shoot is inferred to continue to the surface, but it may be offset to the east by a small fault. Diamond drilling under the DMEA contract indicated that the central ore body extends below the No. 11 adit level (225 feet).

The scheelite-bearing tactite ore bodies measured as much as 16 feet in thickness; however, most of the ore bodies were approximately 4 to 10 feet thick. To a depth of about 100 feet the ore was highly oxidized and had a crumbly, often gossan-like, structure caused by oxidation of pyrrhotite and pyrite to limonite. Oxidation appeared to have enriched the ore appreciably from 20 to 50 feet below the surface. This shallow ore body was 20 feet wide and seemed to be localized either in a foot-wall roll or a flattening of the structure.

#### EXPLORATION AND DEVELOPMENT

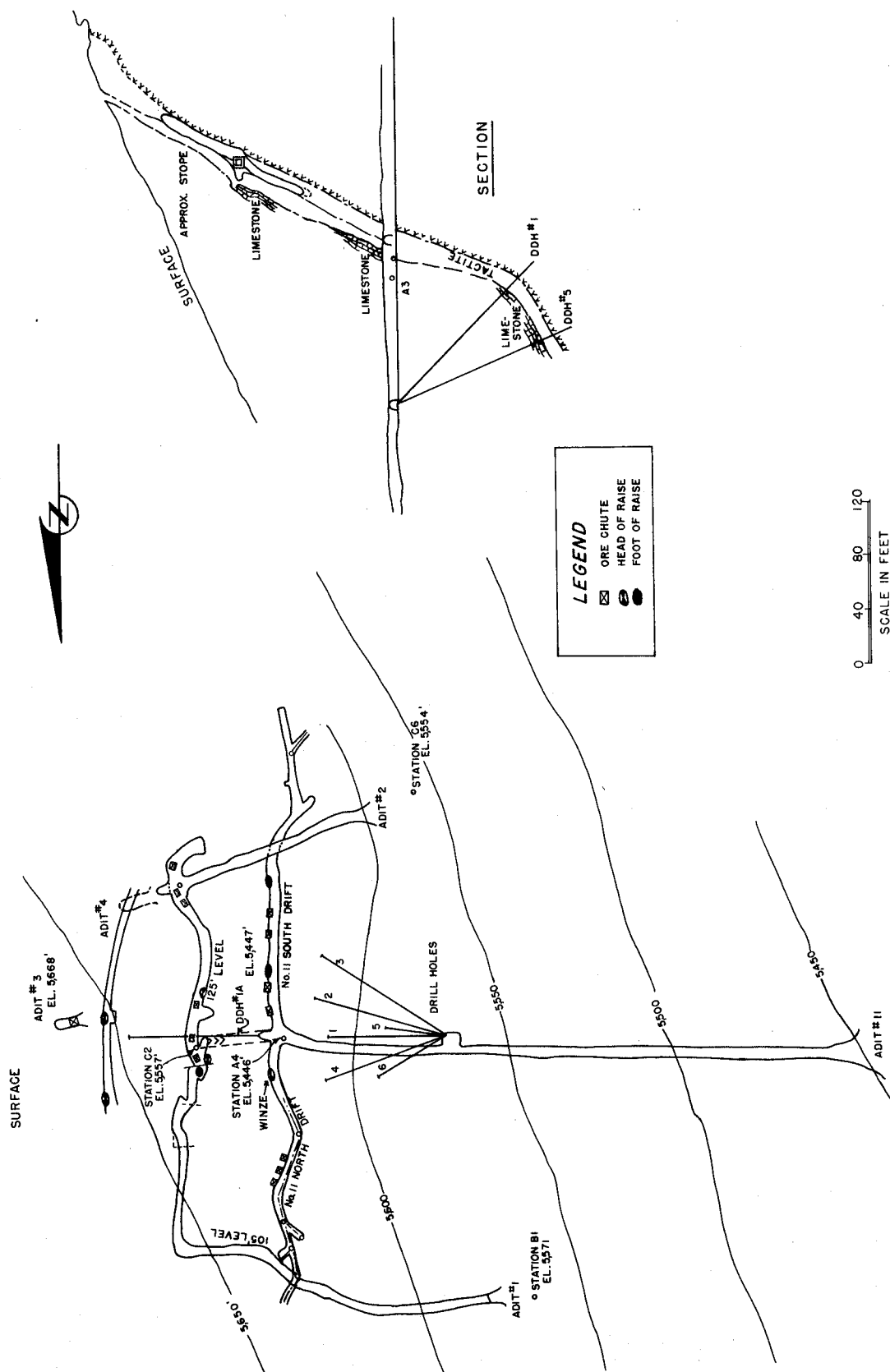
From 1942 through 1944, exploration and development comprised crosscut adits Nos. 1 and 2 driven 220 and 140 feet, respectively, to the ore zone 135 feet below the outcrop), 8 short adits, and several opencuts and pits. This work exposed tactite mineralized with scheelite. Two ore bodies were partly mined above the No. 2 adit level, and a winze was sunk 60 feet below the No. 2 adit level.

In 1951 work was begun on the No. 11 crosscut adit, 113 feet vertically below the No. 2 adit level, to explore the downward continuation of the ore bodies found on the No. 2 adit level. Work was suspended at 236 feet before the contact was reached.

In 1953 exploration under the DMEA contract comprised trenching by bulldozer south of the surface tactite exposure for approximately 500 feet, advancing the No. 11 crosscut adit an additional 198 feet to cross the mineralized zone, and drifting south along the tactite ore structure for 180 feet. Approximately 1,000 feet of diamond drilling was done to determine the vertical and lateral extent of the mineralized tactite. Figure 2 is a plan and section map of exploration and development at the Stormy Day mine.

The No. 11 crosscut adit met the tactite zone at 415 feet. The ore zone was 16 feet wide at the intersection and was mineralized with scheelite. Two ore bodies, having an average width of 8 feet and 50 and 70 feet in length, continuous to the No. 2 adit, were exposed in the drift driven to the south. The ore was sampled by drilling test holes as nearly at right angles as possible to the structure at 5-foot intervals along the mineralized segment of the contact. Drill cuttings were analyzed and results used to obtain a weighted average grade of the ore along the No. 11 drift.

Another phase of the exploration was diamond drilling to explore the downward extension of the ore zone laterally and below the No. 11 adit south drift. A station was cut in the south wall of No. 11 adit (see fig. 2), and six holes were drilled. A hole was drilled from the end of No. 11 adit to explore for a possible parallel





ore zone in the east granite footwall. Four of the holes were drilled to penetrate the mineralized tactite zone 100 feet below the No. 11 adit south drift, and 2 holes were drilled to cut the tactite zone 185 feet below the No. 11 adit south drift, as follows:

Hole No.	Bearing	Inclination, degrees	Length, feet
1 .....	East	-45	135
2 .....	S. 57° 34' E.	-42	143
3 .....	S. 56° 18' E.	-40	184
4 .....	N. 71° 34' E.	-42	130
5 .....	S. 85° E.	-67	132
6 .....	N. 62° E.	-67	172

Three of the shallower holes penetrated the tactite ore zone 100 feet below the No. 11 adit south drift. These holes indicated ore of the same width, length, and thickness as that developed on the No. 11 adit south drift. The deeper holes penetrated the mineralized tactite 185 feet below the No. 11 adit south drift, but the mineralized zone could not be classified as ore.

Six raises were driven from No. 11 adit south drift to determine the grade of the mineralized tactite and to block out ore. Raises 1 and 4 were driven to connect with the level above. Samples of the raise material showed it to be of ore grade.

#### MINING

The topography of the area was favorable for initial development and exploitation of the deposit above the No. 11 adit by crosscut adits, drifts, and raises for shrinkage-stope mining. Drift, shafts, or winzes will be necessary below the No. 11 adit.

The ore was mined by shrinkage stoping because the ore bodies had firm walls, were moderately wide, and dipped 50° to 60° - ideal conditions for this system of mining. The stopes were run longitudinally mined from wall to wall. The stopes were not excessively wide. Only random pillars were left, as no large areas of insecure ground were encountered. Timber requirements were minimum. Drifts and crosscuts were 5 by 7 feet in cross section and untimbered. Under these conditions, more than 95 percent of the ore was mined in successive inclined slices, working upward from the No. 11 adit south drift. (See fig. 3.) The same method was used in mining above the No. 2 adit drift. After each slice was mined, enough broken ore was drawn from below to provide working space between the top of the broken ore and the back of the stope. The dilution of ore with waste was insignificant, and no underground sorting was done. Stopboard chutes were spaced 10 to 20 feet apart. A 10-foot level pillar was left between the haulage drift and the stope. One draw point was used in the south drift from the No. 11 adit. The draw point was excavated by driving a drift round at right angles to the development heading, then raising one round before inclining the draw point back over the top of the drift heading. The sill of the stope was begun 10 feet above the back of the development drift.

Difficulty was experienced in breaking the massive crystalline limestone in the drifts and crosscuts. Jack-leg-type machines were used with 7/8-inch, carbide-tipped drill steel 4, 5, and 8 feet long. The bit size was 1-1/2 inches. Twenty-eight holes were drilled in the drifts and crosscuts using a 5-hole burn cut for a 5-foot advance; 140 sticks of 1-1/2- by 8-inch, 40-percent, gelatin dynamite were used per round. Holes 6 to 8 feet deep were drilled in the stopes, and explosive consumption averaged about 1/2 pound per ton of ore.

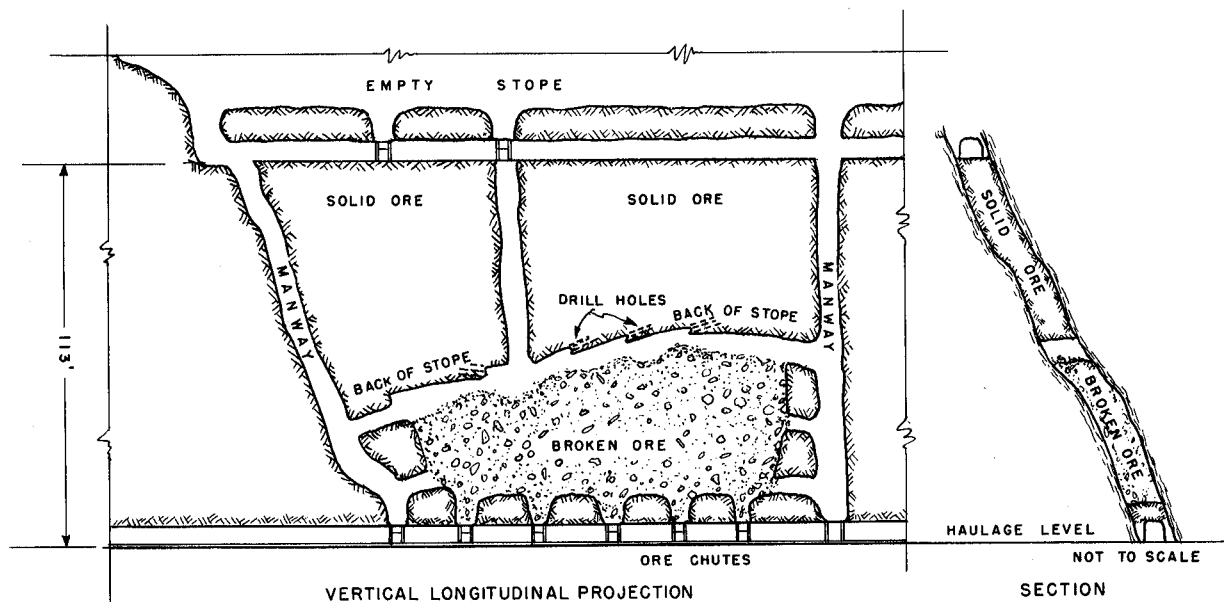


FIGURE 3. - Shrinkage-Stope Mining, Stormy Day Mine.

Virtually all of the loading from drifts, crosscuts, and draw points was done by a Model 12B Eimco loader. The ore was hauled approximately 1,000 feet by an Eimco air trammer on a track having a grade of 1 to 1-1/2 percent in favor of the loaded cars. The track was laid with 16-pound rails on wooden ties.

#### SURFACE PLANT

The surface plant included a combination dormitory and cookhouse equipped with necessary facilities for housing employees at the property. The office building was a 21-foot trailer. The shop, well equipped with tools and machines needed to conduct mining operations at a small property, was in a 20- by 40-foot frame building where repairs and blacksmith work were done.

#### SUMMARY OF EQUIPMENT

Mining equipment at the Stormy Day mine comprised the following items:

<u>Number</u>	<u>Equipment</u>
1	100-ton steel ore bin.
1	Compressor, 315-c. f. m., Ingersoll-Rand
1	Compressor, 315-c. f. m., Atlas-Copco.
1	Compressor, 210-c. f. m., Schramm.
1	Trammer, compressed-air, Eimco.
1	Loader, Model 12B, Eimco.
2	Mine cars, 22-cu. ft., rocker-type.
2	Pusher legs.
1	Slusher, double-drum, Ingersoll-Rand.
1	Tugger, single-drum, Ingersoll-Rand.
2	Stope hammers, Ingersoll-Rand.
1	Stoper, Copco B-2.
3	Drills, jack-leg-type.
1	Generating plant, gasoline, small.

Number

2

Equipment

Steel-sharpening jibs.  
Air receivers.  
Water tanks.  
Bit grinder, portable.

## VENTILATION AND DRAINAGE

The mine had good natural ventilation and no water-drainage problem.

## LABOR CLASSIFICATION AND WAGES

An average of 7 men, working 1 shift, was employed during development. All drilling and blasting were done during the first half of the shift.

Bunkhouse, boardinghouse, and family accommodations were provided, and employees were furnished accommodations and board in addition to their monthly wage. Working conditions were good, and labor turnover was relatively low. Job classifications and monthly wages were as follows:

<u>Classification:</u>	<u>Monthly wage</u>
Lead miner .....	\$475
Miner (stope) .....	416
Miner (development) .....	450
Trammer (development) .....	350
Trammer (mucker) .....	400
Surfaceman .....	325
Cook .....	235

## SUMMARY OF COSTS

The charge for trucking ore to the United States Vanadium mill at Bishop, Calif., was \$0.035 per ton-mile; to the Getchell mill at Redhouse, Nev., \$0.0325 per ton-mile; and to the Toulon mill \$3.50 per ton.

Mine: Stormy Day

Mining method: Shrinkage-stope

Ore mined: 15,000 tons

Period: September 1955 to October 1956

Size of excavation, feet: Drifting, crosscutting, raising - 5 by 7

Proportionate costs of labor, power, and supplies; percent

	<u>Development</u>	<u>Mining</u>	<u>Total</u>
Labor:			
Drilling and blasting .....	18.83	22.48	21.42
Mucking .....	7.32	5.58	6.09
Haulage .....	7.32	6.87	7.00
Supervision .....	7.32	9.87	9.13
General .....	6.70	6.86	6.81
Total, all labor .....	47.49	51.66	50.45

Proportional costs of labor, power, and supplies; percent (Con.)

	Development	Mining	Total
Power and supplies:			
Rental of mining equipment .....	22.42	18.39	19.56
Explosives, fuse, caps .....	6.54	8.51	7.93
Timber .....	1.50	1.53	1.52
Air compression .....	3.55	3.52	3.53
Drill steel .....	3.92	3.37	3.53
Miscellaneous repairs and spares .....	1.50	1.53	1.52
Miscellaneous .....	5.60	7.66	7.07
Track and ties .....	5.61	-	1.63
Water and air lines .....	1.87	-	.54
Vehicle travel .....	-	2.68	1.90
Gas and power .....	-	1.15	.82
Total, labor, power, and supplies .....	100.00	100.00	100.00

Labor, man-hours per ton, and tons mined per man-shift

	Development	Mining	Total
Labor (man-hours per ton):			
Underground:			
Blasting and drilling .....	0.571	0.400	0.432
Mucking .....	.286	.133	.162
Haulage .....	.286	.133	.163
Supervision .....	.133	.102	.108
Surface: General .....	.327	.190	.216
Total man-hours per ton .....	1.603	.958	1.08
Underground:			
Number of employees (excluding supervision)	2	5	7
Average tons mined per man-shift .....	7	12	10.57