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DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

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NO. 13

ANTIMONY IN OREGON

by

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Department of Geology and Mineral Industries

1944

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FOREWORD

Early in the war period, there was a great need for increasing domestic supplies of all metals, particularly those which formerly had been imported to supply our industries. Antimony was one of these metals.

The survey of antimony deposits in Oregon was undertaken for the purpose of stimulating prospecting for and production of the metal at a time when antimony supplies in this country were critical. A secondary reason was to study the relative importance of antimony oxide and sulphide ores in Oregon deposits, and to determine whether oxide ores were being overlooked. The oxide ores are not nearly as well known as stibnite, the sulphide, commonly considered to be the only commercial ore of antimony.

This report is one of a series which the Department has made in its study of Oregon's war mineral deposits.

F. W. Libbey,
Director

October 3, 1944.

ERRATUM

Page 3, par. 4, line 2: rhodamine B instead of rhodamine B[6].

CONTENTS

ILLUSTRATIONS

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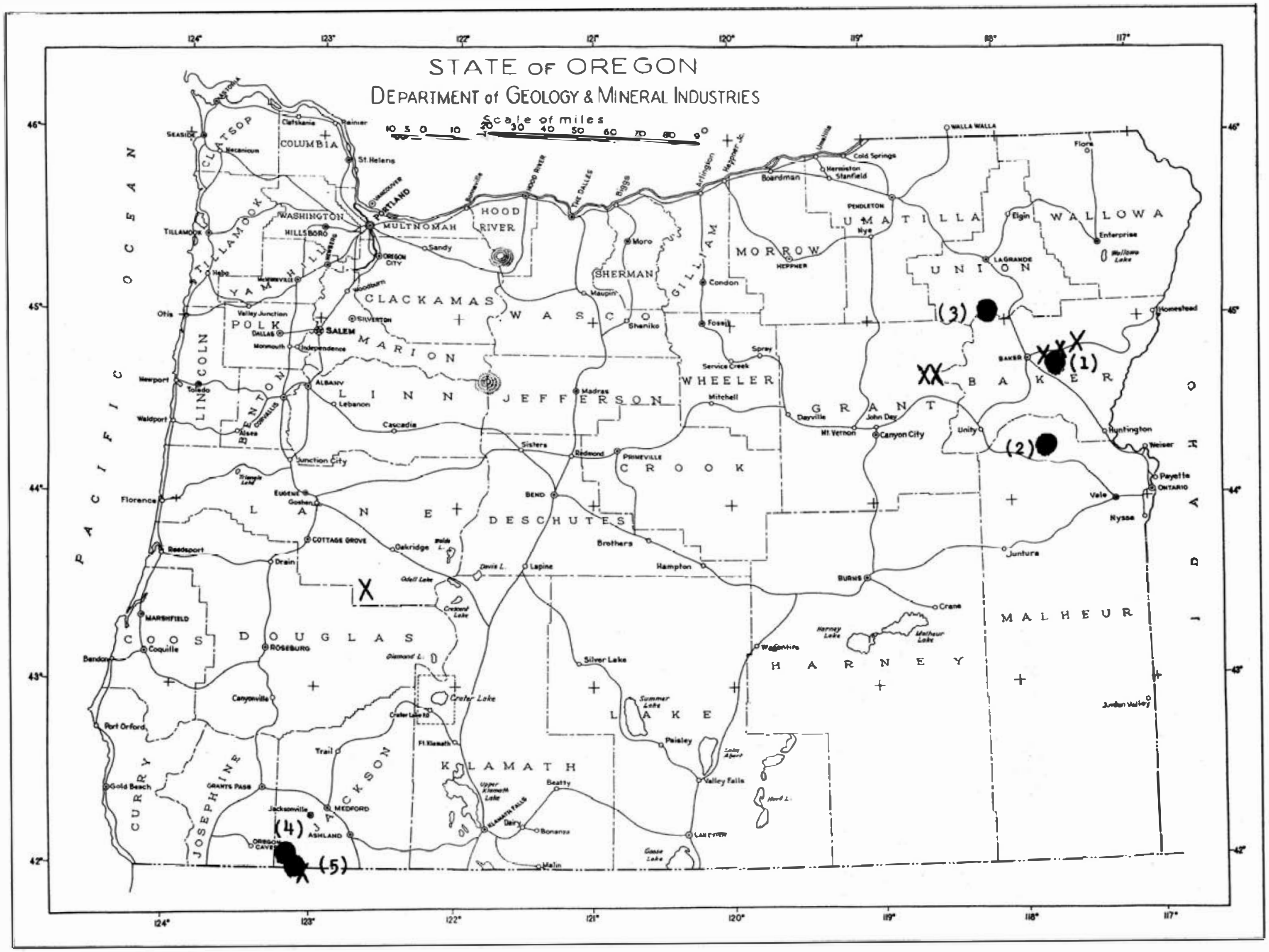

MINES HAVING A RECORD OF ANTIMONY PRODUCTION

(1) Gray Eagle (2) Coyote (3) Stibnite (4) Jay Bird (5) Lowry

Other occurrences: X.

INTRODUCTION

The ensuing report is the result of an investigation of antimony deposits within the state. The investigation was designed to bring Department records of antimony deposits up-to-date, and to encourage production of antimony ore in the war emergency.

Since antimony is one of the relatively uncommon metals about which little is known by the average prospector, the report includes not only a brief discussion of the general geologic occurrence of antimony, but also some data on world production, prices, imports, and uses as well.

All known deposits in the state with a record of production are described. In addition, all known prospects are listed and two of the more promising ones are discussed.

When the study was started antimony was classed as "strategic," and domestic production was being stimulated as much as possible by Government agencies. During 1942 and 1943 domestic production increased considerably, and in addition a large quantity of ore was imported from both Mexico and South America, so that supplies of antimony are now readily available for essential uses. The effect has been to lessen interest in obtaining new domestic production.

ACKNOWLEDGMENTS

The writer wishes to extend his thanks to Messrs. Anthony Brandenthaler and S. J. and E. P. Merrick for their splendid cooperation in furnishing shipment and assay records; to Messrs. H. B. Menardi of the Harshaw Chemical Company and Fred H. Dakin of the Texas Smelting and Mining Company for information furnished and helpful comments concerning the significance of oxide ores; to Mr. Ray C. Treasher, Dr. W. A. G. Bennett, Dr. W. D. Lowry, and Mr. L. L. Hoagland for their data on mines and prospects in southwest Oregon, petrographic determinations and assays; and to Mr. F. W. Libbey and Dr. H. C. Harrison for their respective reviews of the manuscript and the computations contained therein, and their many constructive and helpful suggestions.

PRODUCTION, PRICES, AND USES

The United States has produced but little antimony and that from a relatively few widely scattered deposits. These occur chiefly in Nevada, California, and Idaho, although properties in Arizona, Arkansas, Montana, Washington, and Oregon have contributed to this production. Recently, deposits in Alaska, where rather widespread antimony mineralization has long been known to exist, have been developed. The remarkable mine at Stibnite in the Yellow Pine district, Idaho, is the largest single producer in the United States. This production is augmented by antimony obtained as a by-product in lead refining and from scrap, and such plants as the Bunker Hill and Sullivan at Kellogg, Idaho, and the new electrolytic antimony plant built by the Sunshine Mining Company at Big Creek, Idaho, are important factors in domestic production.

Domestic consumption of antimony greatly exceeds domestic production and the difference is made up by imports. China supplied most of these imports until the war interfered with normal commerce. Since then this country has depended mainly on imports from Mexico and South America, particularly Bolivia and Peru.

The increased production from these countries can be summarized by the following quotations from Minerals Yearbook, 1938 and 1939. "In 1929 China contributed 71 percent of a 35,000-short ton world output, whereas North and South America supplied less than 20 percent; however, in 1937 world output was approximately 38,000 tons, and China produced only 43 percent of the total compared with 45 percent by North and South America. Most of the increase of the Western Hemisphere has been in Mexico, although production in Bolivia, United States, and Peru has improved also."

This trend has continued, and in the following year "As measured by exports, production in China dropped 47 percent, and for the first time in many years that country ranked second in world output. Exports from Bolivia increased 32 percent and were the highest on record. Bolivia thus assumed first place in world antimony production. . . Bolivia, China, and Mexico produced 29, 26, and 25 percent, respectively, of the world antimony supply in 1938; the United States produced less than 2 percent."

The price paid for antimony has fluctuated considerably since World War I. It dropped from a high of slightly over $0.44 per pound in 1916 for ordinary grades of antimony metal to less than $0.05 per pound in several different years after that. A more or less usual price in recent years has ranged between $0.12 and $0.16½ per pound. The current Metals Reserve price on ores and concentrates containing 30 percent antimony is $1.65 per dry short ton unit (20 pounds) of contained antimony. The complete schedule, effective until December 31, 1944, is included in the Appendix.

Like other war minerals, the industrial demands for antimony have increased markedly in recent years, the more important uses being for battery plates and antifriction bearings, although its use in making chemicals has been growing steadily. Appreciable amounts are used in paints and sanitary enamelware. Other uses include type metal, munitions, and electric cable covering. An interesting side light on the subject of use lies in the fact that for many centuries women used stibnite for painting their eyebrows and giving luster to their eyes. In fact, before the discovery of the metal itself, stibnite was called "antimony" and it is reported that the paint used by Jezebel (2 Kings, IX:30) was finely ground stibnite.

GENERAL GEOLOGIC OCCURRENCES

Stibnite is a typical low temperature mineral -- that is, it is deposited from mineralizing solutions in a rather late stage of the processes of mineralization at a time when the temperature and the pressures existing within the vein have lowered appreciably. The mineral is known to be forming in many hot springs today, and some deposits are undoubtedly of hot springs origin. This, however, is more the exception than the rule, and most antimony occurs in deeper seated veins or lenses with a gangue of quartz and sometimes calcite. It frequently occurs alone with the gangue minerals, but when it is accompanied by other minerals they are often one or several of the following: pyrite, arsenopyrite, sphalerite, some of the silver and copper minerals, and cinnabar. It occurs as replacements too, particularly in limestones and shales where it forms lenses along contacts, fracture zones, etc.

Stibnite is fairly resistant to attack by most acids but it reacts readily with alkaline solutions. Once altered to oxides, antimony is quite stable and not given to solution and reconcentration.

The common ore minerals of antimony and their compositions are:

Stibnite	Sb_2S_3
Stibiconite	$H_2Sb_2O_5$
Senarmontite	Sb_2O_3
Cervantite	$Sb_2O_3Sb_2O_5$
Valentinite	Sb_2O_3
Livingstonite	$HgS \cdot 2Sb_2S_3$

In addition, many copper, silver, and lead minerals contain antimony and it is ultimately recovered from some of these during the process of extracting the other metals. A chart of antimony minerals, together with their physical characteristics, is given in the Appendix.

Particular attention is called to the oxides because a popular fallacy is the belief that stibnite, the sulfide, is the only ore mineral of antimony. True, stibnite is the major source of antimony, but, no less true, the various oxides and livingstonite are also important sources. Thus, in the Altar and Caborca districts of Sonora, Mexico, the antimony ores are highly oxidized, the antimony mineral being chiefly stibiconite; these districts have probably been the largest and most consistent producers of antimony ore in Mexico during the past 25 years. Likewise, livingstonite constitutes a notable ore body at the Huitzuco mine, Guerrero, Mexico,* and both senarmontite and valentinite are found in large amounts in the mines of Djebel-Haminate and Sensa in Algeria. Bindheimite, a hydrous antimonate of lead, was the chief ore at the Montezuma mine in Nevada, and, although this was primarily a silver mine, the ore carried appreciable quantities of antimony; thus the mine was listed in the antimony chapter in Mineral Resources of 1918. By far most of the production of the Gray Eagle mine in Baker County is from a mixture of oxides rather than from stibnite, and it is because of this fact that this point is being emphasized, as additional finds in this district at least may depend on recognition of the oxide minerals.

DESCRIPTION OF MINERALS, TESTS, AND OCCURRENCES

Stibnite, Sb_2S_3, is easily recognized. It commonly occurs as needles in quartz or in confused aggregates or radiating groups of crystals. It is dark gray to black, with a metallic luster, highly splendent on a cleavage or fresh crystalline surface. Streak is lead gray. It is soft, the hardness being only 2, and it is fairly heavy with a specific gravity of 4.52 - 4.62. Fusability is a very diagnostic property and the corners of a crystal will frequently fuse under the flame of a match. Crystal form and specific gravity will usually serve to distinguish stibnite from galena.

The oxide minerals are less well known and are much more difficult to recognize. Kermesite is cherry red, very soft, and moderately heavy. It results from the alteration of stibnite and usually occurs in tufts of capillary crystals. It is not an ore mineral in itself in that it rarely occurs in any quantity, except in one deposit in Italy, and it is mentioned here only because its recognition might prove of value to the prospector. The other oxides make notable ore bodies. In general they are soft and quite similar in appearance, varying from light yellow to pale gray or white in color. Weight is perhaps the most significant criterion. Thus, when antimony mineralization is suspected, any heavy gouge-like materials should be given especial attention as the oxides frequently resemble gouge and "formation" closely, especially when they occur associated and intermixed with such materials and show little or no stibnite. Under such circumstances, the weight is particularly diagnostic. Oxides range between 4.0 and 5.8 in specific gravity, or, piece for piece, are comparable to such well-known minerals as zinc blende (4.0), barite (4.4), magnetite (5.2), and scheelite (5.9) in weight. If the mineral conforms in color and weight to the properties of an oxide, the prospector can then try to confirm its presence by searching the vein for stibnite, as small unoxidized peds of the sulphide will in all likelihood be found to exist scattered through the oxide or as needles enclosed in associated quartz.

There are several qualitative tests for antimony. Two recently developed ones are the rhodamine B[6] test and the phosphomolybdic acid test. These are positive and comparatively simple. In addition, there is a blowpipe test in which a pale sublimate on charcoal indicates antimony in the substance tested. However, this test is subject

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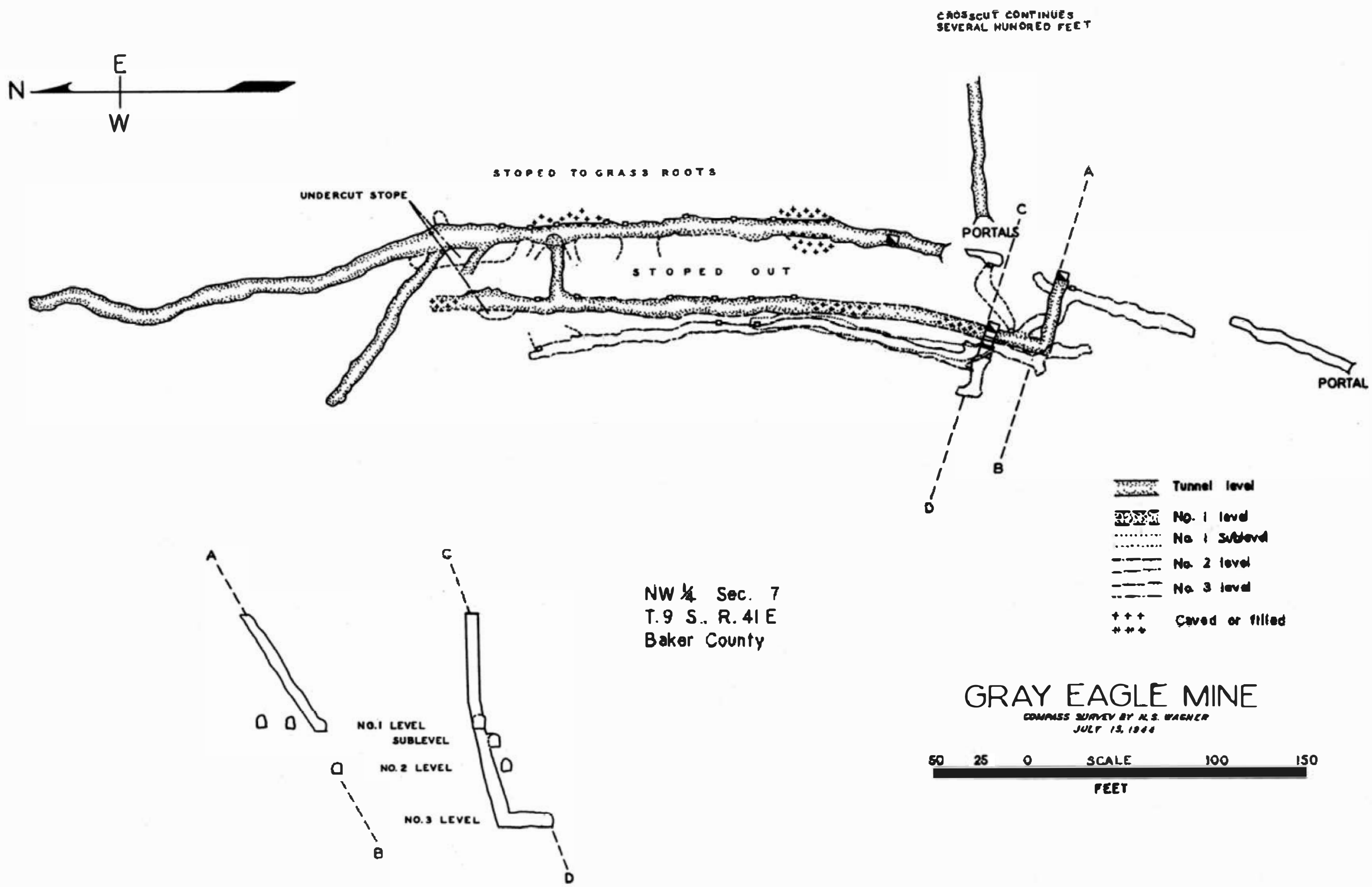
* 1. Mercury Deposits of Huitzuco, Guerrero, Mexico, By C. W. Vaupell. Mining Technology, Sept. 1937. Tech. paper 842.

2. Metallurgy of the Huitzuco Mercury Ores, By David Segura. Metals Technology, Feb. 1938. Tech. paper 896.

3. Reduction of Livingstonite Concentrate, By H. B. Menardi. Metals Technology, Feb. 1939. Tech. paper 1042.


N
E
W
CROSSCUT CONTINUES SEVERAL HUNDRED FEET
STOPED TO GRASS ROOTS
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PORTALS
PORTAL
A
B
C
D
Tunnel level
No. 1 level
No. 1 Sublevel
No. 2 level
No. 3 level
Caved or filled
NW ¼ Sec. 7
T. 9 S., R. 41 E
Baker County
NO. 1 LEVEL
SUBLEVEL
NO. 2 LEVEL
NO. 3 LEVEL
GRAY EAGLE MINE
COMPASS SURVEY BY H. S. WAGNER
JULY 15, 1944
50 25 0 SCALE 100 150
FEET

to interference by the presence of other elements, and, unless an individual is adept in using a blowpipe, it is not entirely satisfactory. Details of the procedure and equipment necessary for these tests are to be found in the Appendix, but they are included for completeness and for those interested in analytical procedure rather than as recommended field tests. As in all prospecting, an assay of a carefully taken sample is the best conclusive step to take, as an assay not only confirms the presence of the element in question but gives its percentage as well. The prospector would do better to study typical antimony ore minerals thoroughly in order to become familiar with their physical properties, rather than to depend upon these qualitative tests.

ANTIMONY MINES IN OREGON

There are five mines in Oregon which have a record of antimony production. These are the Gray Eagle (formerly the Koehler), the Coyote, the Stibnite (also known as the Parker), the Jay Bird, and the Lowry mines. A description of these mines together with a brief discussion of prospects follows.

THE GRAY EAGLE MINE

General:

The Gray Eagle mine, formerly known as the Koehler, is located five miles east of Baker in the NW$\frac{1}{4}$ sec. 7, T. 9 S., R. 41 E. It is owned by Pat O'Brien of Baker, and is under bond and lease to Anthony Brandenthaler who is shipping ore (July 15, 1944) both to the Metals Reserve Company purchasing depot at Seneca, Oregon, and to the American Smelting and Refining Co. smelter at Midvale, Utah.

History:

The property was first worked in 1907, according to an article credited to the Morning Democrat, Baker, Oregon, on April 18 of that year. The article states:

> "Ray Brothers have just received returns from their shipment of antimony to the Oakland, California Smelter . . ."
>
> "They say that they have received a net profit of $1,000.00 from the carload of stibnite and oxide, that it was at least $500 more than they expected, and that the smelter people informed them that their ore was more free from contaminating elements than that of other antimony mines in the United States, with the exception of one in Nevada. The ore was said to contain no arsenic, copper, or lead and to be easily milled.
>
> "On account of the high freight rates from the city of Oakland to Baker, the owners of this mine are preparing to install a smelter on the site of the mine which is about 4 miles from Baker. The ledge, which ranges in width from 12 to 20 inches, has been uncovered a distance of 50 feet, and shows signs of widening as it goes.
>
> "There are few antimony mines in the country, the total output during the past year being 1,750 tons, valued at $346,980."

No smelter was ever built, but the mine has been worked intermittently ever since and has produced 245 tons of antimony metal as calculated from existing smelter receipts. An appreciable additional tonnage is known to have been produced beginning with Ray Brothers' shipment just referred to, and including some others as well, but in the absence of actual records no estimate of it is included in the above figure.

Development:

As shown on the map of the mine opposite page 5, the surface tunnel, the inclined shaft, and the northern part of the first drift (stippled areas) outline the extent of the early (World War I and earlier) operations. All other development work has been done by various operators in recent years, and, while some of the recent production came from pillars and small lenses discovered within the bounds of the early work, most of this production resulted from the recent development.

The inclined shaft is 75 feet deep on a slope of 57° to the west. It is used as a manway. Between the first level and the surface the vertical shaft is used solely for hoisting. Below the first level it serves as an all-purpose shaft. It starts inclining a short distance above the first level and continues on a 78° slope for 55 feet, N. 73° W., to the third or bottom level. Its total vertical depth is approximately 115 feet.

The sublevel (dotted on the map) below the first or main drift was opened by a former operator as an alternative to cleaning out a caved area in the main drift north of the shaft, his object being to reach the north end of the old workings for purposes of sampling and prospecting.

The third level is currently being driven to the north, having been opened about 45 feet to the north and 6 feet to the south since the survey was made.

Geology:

The geologic map of the Baker quadrangle* shows biotite quartz diorite, gabbro, silicified gabbro, and a small area of Elkhorn Ridge argillite in the immediate vicinity of the mine. The vein strikes north, dips west, and, in part at least, occurs in the argillite.

Vein material occurs in a strong, well defined zone, usually about two feet wide, but sometimes swelling to as much as six to eight feet. A small quartz vein from two to ten inches wide runs through this zone. High-grade antimony ore occurs as irregular and erratically spaced lenses closely associated with this quartz. These lenses have been found as much as three feet thick, although, for the most part they are from six to eight inches thick. They are mixed stibnite and oxide. Values in antimony, mainly as oxides, are distributed more or less throughout the whole width of the vein and continuously between high-grade lenses for more than 200 feet along the strike. As will be pointed out later, it is from this disseminated antimony that a significant proportion of the total production has been derived.

The ore is remarkably pure as is shown by the following analyses furnished by Mr. Fred H. Dakin, through the courtesy of the Texas Mining and Smelting Company:

	1	2	3	4
Antimony	40.3 %	44.0 %	58.3 %	32.0 %
Arsenic	0.002	0.02	0.07	0.4
Lead	0.005	0.08	0.03	None
Copper	None	0.03	None	None
Zinc	None	0.04	None	None
Selenium	----	None	None	None
Gold	0.096 ozs.	0.06 ozs.	0.12 ozs.	0.32 ozs.

1. Sample of sulphide ore taken in about 1940.
2. Sample of sulphide ore taken in 1942.
3. Sample of oxide ore taken in 1942.
4. Sample of straight unsorted mine ore containing quartz. The arsenic content of this sample is apparently derived from the associated vein matter.

Calculations based on the sulphur content of 985 tons (twenty-five shipments) of run of mine low-grade ore including some rejects from which high-grade had been sorted, and some dump material used to bring individual shipments up to capacity, show that there is only enough sulphur available to combine with 13.7 percent of the antimony content present, assuming that all of the sulphur present is combined with antimony to form the compound Sb_2S_3. The remaining 86.3 percent of the antimony content of this ore occurs as antimony not combined with sulphur. It is chiefly stibiconite and cervantite.

Present practice is to put the development rock over a grizzly with half inch openings, sorting the oversize into an ore bin or a reject bin. The rejects are added to the fines or put over the dump depending on their value. The fines from this separation are shipped primarily as gold ore.

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* U.S. Geol. Survey Bull. 879: Geology and mineral resources of Baker quadrangle, Oregon, by James Gilluly, 1937.

During recent operations (February 27, 1941 to July 15, 1944) a total of 1179 tons of ore has been so sorted and shipped, including 106 tons of sorted high-grade averaging 49.2 percent Sb, and 1073 tons of fines averaging 11.2 percent Sb.

For the most part the gold and silver content is low, averaging 0.27 oz. to the ton and 0.13 oz. to the ton respectively per shipment. However, the gold content tends to be quite variable. The highest grade shipment, a car of 38 tons, ran 0.91 oz. to the ton in gold and contained 17 percent antimony. The lowest grade shipment, a car of 43.5 tons, ran 0.10 oz. to the ton in gold.

The best gold ore has come from the stopes above the first level south of the vertical shaft. A cross fault has disturbed the vein here and this may have a bearing on the local enrichment. High-grade antimony ore was sparse in this part of the mine but the fines shipped from this area averaged somewhat higher than the prevailing average for the mine.

Although the recent operations have accounted for most of the recent production, no great amount of ore may be seen, as all ore developed has been mined except remnants and pillars of relatively marginal grade. However, although there is but a small amount of ore in sight at present, there is good evidence to indicate that more will be found with depth.

Ore was encountered throughout the entire length of the second level, with the best antimony values occurring in the center third of the northern extension where the vein was steepest. Near the north end of the drift a lens of high-grade ore apexed within the bounds of the drift. This lens was nearly three feet wide and was composed almost entirely of massive white oxide. A small parting of formation appeared near its base but the drift was undercut and filled here, and Mr. Brandenthaler reports that this parting disappeared entirely a short distance below the track whereas the oxide retained its width. The vein steepens in dip with depth. Ore which appears to be of comparable quality to that in the second level has been exposed by the current development in the third level.

From the evidence now available the ore in the lower levels seems to be approximately the same in quantity and assay value as it was in the near-surface tunnel.

Although considerable stibnite has been encountered in the lower workings, it is not at all certain whether this is just a local occurrence or whether it indicates an over-all change in the character of the ore. The stibnite occurs chiefly in the thicker lenses or bunches of ore, and then usually as a core surrounded by oxide. It is scarce when the ore occurs in thin veins and stringers, which are mostly oxide. As this is so, the presence of stibnite in the bottom level cannot be taken alone as indicative of a change in character of the ore. The presumption is that the apparent lack of sulphide in the upper levels is in all probability due to the fact that it constituted the heart of the high-grade spots that were mined out, as the Ray Brothers are reported to have shipped "stibnite and oxide" from their discovery operations.

The average sulphur content of 25 shipments of low-grade in which sulphur was reported is ~~six~~ 0.6 percent. The average sulphur content for shipments from the third and future lower levels should show whether or not any material over-all change in the character of the ore is imminent.

The proportion of high-grade to low-grade obtained thus far has been low, and production from the high grade alone has been small accordingly. Although this is so, the value of the fines and low-grade occurring between high grade lenses is good and remains quite constant. The development of an effective method of concentration might prove profitable as, with a means of concentrating the fines, the tonnage of ore shipped as antimony ore would be increased considerably. Only a 50 percent recovery of the antimony in the fines which have been shipped during recent operations would have exceeded the antimony content of the tonnage shipped as high-grade. Whether or not the value accruing from such an increase in high-grade shipments would offset the cost of concentrating and the possible loss of revenue from the gold content of the fines is open to question. At the present time the smelter pays a few cents a unit for the antimony contained in the fines. This generally pays for the principal charges so that the otherwise marginal gold content remains as profit.

Several jig tests have been run on the ore, but, whereas good grade of concentrate was reportedly obtained, the percent recovery was quite low. In general, the problem of concentrating the low-grade in a simple plant is more difficult than might be supposed, as the oxides slime easily. However, further careful study of the problem should be made.

COYOTE MINE

General:

The Coyote mine is owned by the Eastern Oregon Land Company, Ontario, Oregon, and is located about 14 miles west of Brogan in sec. 31, T. 14 S., R. 41 E. and sec. 36, T. 14 S., R. 40 E. It is on the south slope of Cow Butte, near the summit.

History:

The property was first worked in 1908 at which time two cars of selected high-grade ore were shipped to the Selby Smelter, California. It was worked again in 1917 and one car of ore was shipped. Although some development work was done in 1940 by Mr. I. S. Moudy, Long Beach, California, these three cars constitute the only known production from the property. Smelter returns showing the exact tonnage shipped and the antimony content are not available. The mine is inactive at present (July 1944).

Geology:

As much of the work done up to and including 1940 is now obscured, the following description of the geologic conditions is quoted from a departmental report made by Mr. H. K. Lancaster* in 1940. Mr. Lancaster examined the property several times in 1940 and 1941.

"The country rock is biotite diorite and schist. The contact between the diorite and schist runs N. 45° W. through the property near the base of Cow Butte. All of the stibnite occurrences are in quartz veins in the diorite.

"A four-foot basalt dike striking N. 45° W. and dipping 70-80° NE cuts the diorite. A quartz vein, varying in width from 2 to 12 inches closely follows this dike. This vein has been traced for 1000 feet by pits and trenches. The vein filling is broken and in several of the pits lenses of stibnite were found. At the time of examination no high-grade antimony ore was exposed. Individual specimens, however, would run as high as 50% antimony.

"Very little development work has been done. It is possible that further work may expose enough antimony ore occurring in high-grade lenses to ship a few cars. At the time of examination, no shipping ore was in sight."

As the result of an examination made in 1941, Lancaster states:

"More development work on the south side and near the top of Cow Butte has exposed quartz veins on two sides of an 18-foot basalt dike along the contact of the basalt and granodiorite which strike N. 55° W. and dip 80° NE. These veins vary in width from 2 to 16 inches and average about 6 inches. Minor amounts of stibnite are found. The gold content is low.

"The possibility of exposing high-grade stibnite lenses suitable for shipment appears to be remote. Mr. Moudy understands that the possibility of producing antimony ore is a 'long shot,' but wishes to continue development work until he has opened the old workings. . ."

Such observations as the writer was able to make confirm this general picture.

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* H. K. Lancaster, field engineer, State Department of Geology and Mineral Industries.

The early shipments are reported to have been quite high-grade. Specimens reportedly representing this type of ore are massive pieces of stibnite encrusted with oxide. However, the ore exposed at the property today consists chiefly of that piled up at the various test pits. This is made up for the most part of aggregates of stibnite and oxide in quartz, disseminated enough so that it would probably be difficult to bring up the grade by sorting. Assay reports range from 16.1 percent to 63.9 percent. A sample described as "picked antimony ore from the main prospect pit" ran 29.8 percent, and this probably exceeds the average tenor of the ore just described. An analysis* of a sample, as follows, shows it to be comparable to the Gray Eagle ore in purity:

Antimony	16.1 %
Arsenic	0.02
Lead	None
Copper	Trace
Zinc	None
Selenium	None

STIBNITE MINE

General:

The Stibnite mine, also known as the Parker Antimony mine, consists of four unpatented claims situated in the E ½ sec. 5, T. 6 S., R. 37 E. It is owned by Mr. H. H. Parker of North Powder, Oregon.

History:

Little is known of the early history of the mine. Presumably, it was originally opened as a gold mine, but stibnite was found and three cars are reported to have been shipped during World War I. No records of this production are available nor has any subsequent production been reported. Several hundreds of feet of bulldozing was done a few years ago. This consisted of crosscut stripping at both ends of the old vein together with some additional cuts in areas where float has been found.

Development and Geology:

The original workings consisted of a tunnel and a 60-foot surface cut on the vein. The antimony was mined from the northeast part of this cut. The vein, dipping 80° to the northwest, strikes N. 45° E. in a granodiorite which is decomposed and disintegrated to the extent that the vein in the old cut and the results of subsequent bulldozing are entirely obscured. The vein is exposed in one 20-foot shaft and here it varies in width from four inches to one foot. The predominating mineral is quartz which encloses small bunches of stibnite. Apparently the main shoot lay in the cut immediately adjacent to this shaft as some sorted ore and some rejects from the sorted ore are piled along the side of the cut there.

The ore is chiefly stibnite, oxides having developed only to a minor extent. A spectrographic analysis** of a piece of high-grade which assayed 54 percent showed the following impurities:

Lead	0.20 %
Copper	0.08
Arsenic	0.08
Zinc	0.07
Cadmium	0.005
Silver	0.003
Molybdenum	0.003
Bismuth	0.001

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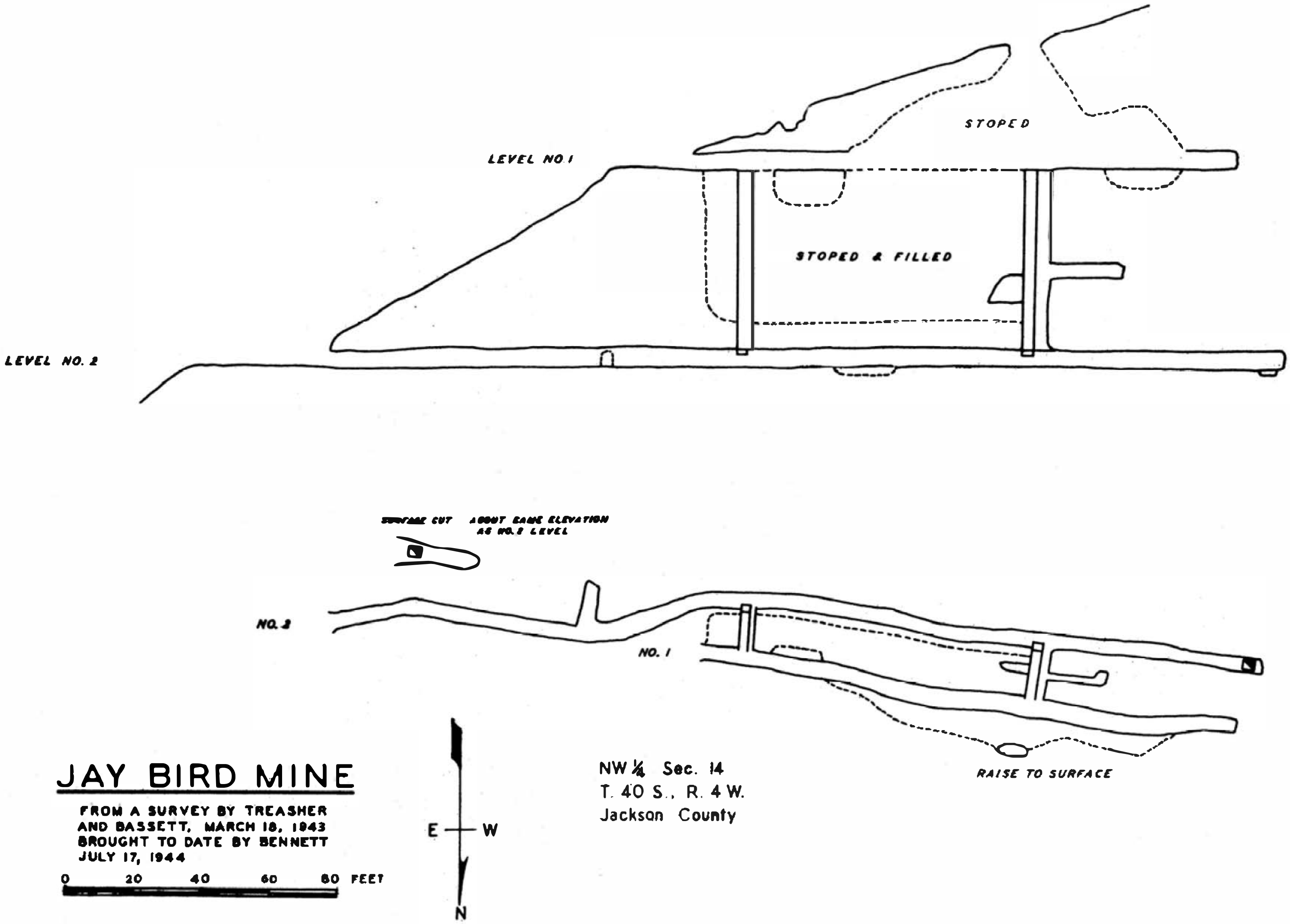
* Harrison, H. C., State Department of Geology and Mineral Industries.

**Harrison, H. C., idem.



STOPED
LEVEL NO. 1
STOPED & FILLED
LEVEL NO. 2
NO. 2
NO. 1
RAISE TO SURFACE
JAY BIRD MINE
FROM A SURVEY BY TREASHER
AND BASSETT, MARCH 18, 1943
BROUGHT TO DATE BY BENNETT
JULY 17, 1944
0 20 40 60 80 FEET
E
W
N
NW ¼ Sec. 14
T. 40 S., R. 4 W.
Jackson County

Although several parallel veins or structures are reported to have been revealed by the bulldozing work, it is understood that they did not offer sufficient encouragement for development work.

JAY BIRD ANTIMONY MINE

Location:

This mine is located in the NW¼ sec. 14, T. 40 S., R. 4 W., Jackson County just north of Kinney Creek, a tributary of the Applegate River.

History:

Unlike the other four antimony mines in the state, all of which produced during World War I or earlier, this property was located as recently as 1939. It is composed of three mining claims, and was acquired by its present operators, Messrs. S. J. and E. P. Merrick, Medford, Oregon, in 1941.

Active operations with a small crew were commenced in April 1941 and, up to July 1944, 111 tons of ore averaging about 47 percent antimony has been shipped. An indefinite but small tonnage is in sight in the mine.

This ore is chiefly stibnite with very minor amounts of the oxides.

Development and Geology:

The mine is opened by two adits which follow a shear zone 275 feet in a N. 80° W. direction (See map opposite page 11). This shear zone dips 80° to the southwest and is in country rock composed of both metasedimentary and meta-igneous members. Some of the metasediments are calcareous, and a petrographic analysis* of the black footwall indicates that it is possibly basalt or gabbro which has been chloritized and serpentinized as well as sheared.

The high-grade stibnite now sorted for ore is usually bladed and massive, and pieces are sometimes surrounded by oxides. It appears to occur as a replacement, forming irregular pods and lenses of variable size in the shear zone. Kermesite is frequently observed on the stibnite and a blue quartz is associated with some of the ore; there is no persistent quartz vein.

To a lesser extent, stibnite also occurs disseminated in the wall rock. Occasional assays of this wall rock show from 8 to 23 percent stibnite, but no systematic sampling has been done and no estimates of possible tonnage or tenor of this low-grade may be made.

Analyses of impurities differ somewhat as shown by the following results:

Analysis made by Texas Mining and Smelting Co.**	
Antimony	55.0 %
Arsenic	0.6
Lead	None
Copper	"
Zinc	"
Selenium	"

Analysis made by American Smelting and Refining Co., Aug. 14, 1941.	
Arsenic	1.05 %
Iron	0.7
Zinc	0.5

Although nearly all the ground above the second level and between the raises has been stoped out, the ore occurred in two poorly defined shoots. The area nearest the portal contained the most clean-cut shoot; the ore in it is said to have ranged between 10 and 24 inches in width. The area beyond this shoot (vicinity of the second raise) was characterized by more scattered lenses of ore extending from the second level to the surface.

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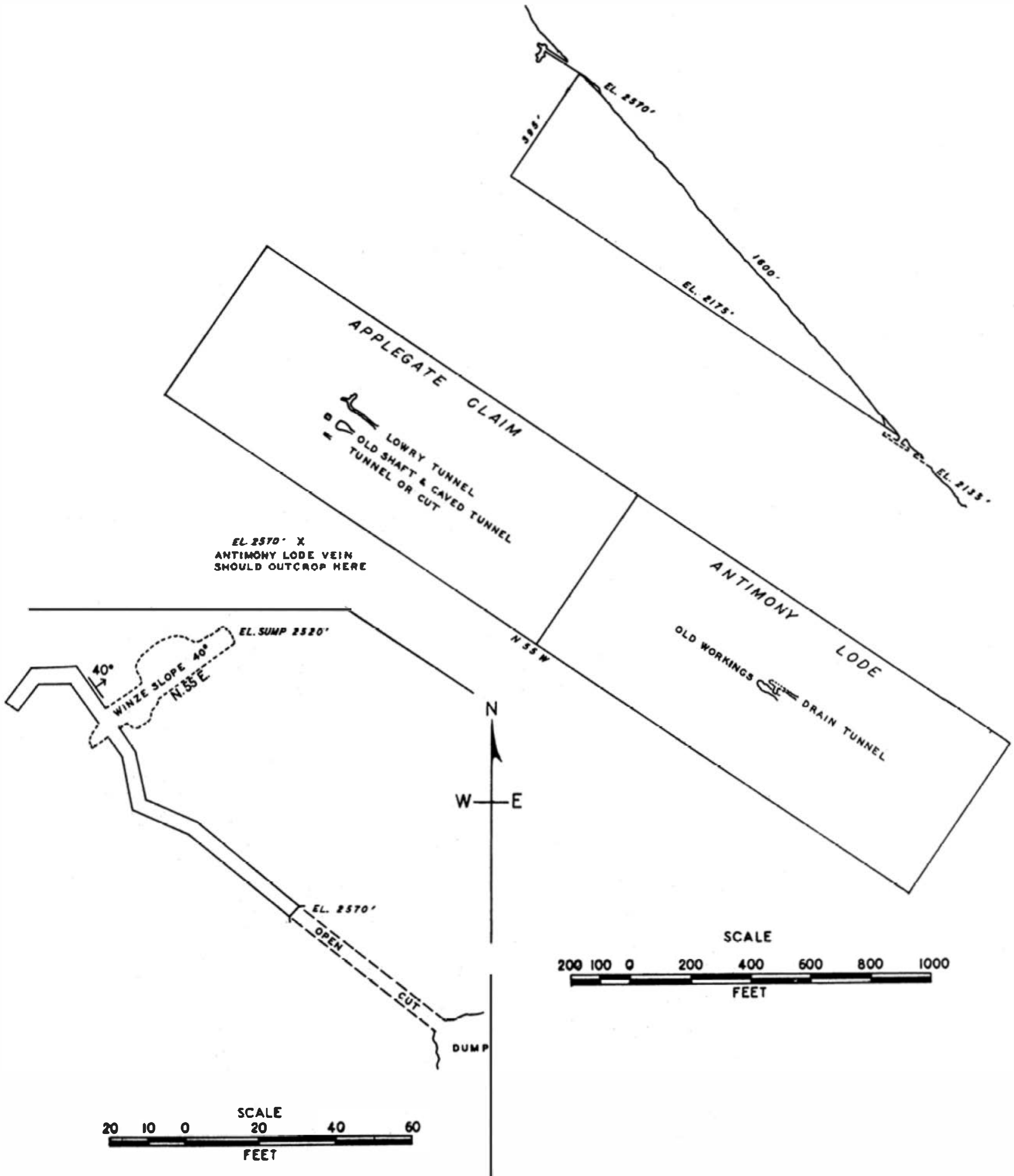
*: Lowry, Wallace D., State Department of Geology and Mineral Industries.

**Letter from Mr. Dakin to Mr. Merrick, August 12, 1941.



NW ¼ NW ¼ SEC. 25
T. 40 S., R. 4 W.
JACKSON COUNTY

LOWRY STIBNITE CLAIMS

REDRAFTED FROM THE MAP OF A BRUNTON & PACE SURVEY MADE BY RAY C. TREASHER ON FEB. 12, 1940

Little or no ore is exposed west of the second raise either in the second or intermediate levels, and all ore in sight above the first level has been mined. Float stibnite has been found on the surface some 200 feet west of the face of the first level. Likewise, a good showing has been found in a surface cut and shallow pit located just south of the portal of the second level on an extension of the shear zone.

All high-grade, even very small pieces, is hand-sorted at the present time. The owners plan to investigate the value of the fines obtained in sorting, and of the low-grade in the mine to see if some means of concentration may be warranted should a suitable tonnage be developed.

THE LOWRY ANTIMONY MINE

General:

This property is located in Kanaka Gulch, Jackson County, in the NW$\frac{1}{4}$ sec. 25, T. 40 S., R. 4 W. It consists of two claims known as the Antimony and the Applegate, situated end to end and located by Bert B. Lowry of Medford, Oregon, in September 1939.

History:

These claims are known to have been worked at various times during the past two decades and they are supposed to have produced several carloads of ore. However, no record of past operations is available. It is reported that sometime in recent years, a Mr. Schumacher, Medford, made a shipment of concentrates from some of the dumps. The property is inactive (July 1944).

Development:

There are several short tunnels and shallow shafts on each claim. Most of them are inaccessible, and none of them is recent. They appear to be on independent lenses.

Geology:

A detailed study of surface geology is restricted by an abundant growth of vegetation, heavy soil-cover, and outcrops which are frequently highly weathered. Workings for the most part are inaccessible, and records are completely lacking. Consequently, only a very generalized account of the prevailing geologic conditions may be given.

The country rock in this region has been generally regarded as being metasedimentary and meta-igneous. Locally, at least, this is not so, as a petrographic examination* of two samples from the tunnel on the Antimony claim showed "little alteration which could not be classed as ordinary weathering." Lowry identified the samples as (1) an andesitic tuff, cut by veinlets of secondary calcite and quartz, and (2) andesite.

The lowest workings consist of a tunnel in the Antimony claim driven to a point presumably underneath an older shaft. This tunnel showed no ore and did not break into the shaft which was open, but was only partially accessible. Short drifts are supposed to have been run in a northwesterly and southeasterly direction from the bottom of this shaft, and there is what appears to be a caved tunnel running to the northwest from the collar level. Some highly oxidized specimens were stacked near the collar, and a bright red coating was observed developed on some of the timbers underground where they were wet. This coating showed on wedges and cut wood, but was most conspicuously developed on the bark of the unpeeled timbers. It is interesting to note that scrapings from this timber bark assayed 9.7% antimony**, and spectrographic analysis*** showed it to run high in calcium, aluminum, and magnesium.

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* Lowry, Wallace D., idem.

** Hoagland, L. L., State Department of Geology and Mineral Industries.

*** Harrison, H. C., idem.

The accessible workings on the Applegate claim consist of a tunnel about 200 feet long in which there is a winze 50 feet deep dipping 40° in a N. 55° E. direction. This winze was open, but the ground was heavy and no attempt was made to examine it. Treasher (1942)* reports that ore is 5 inches wide in the sump and that it twice pinched to 2 inches and swelled to fair-sized pockets in the slope distance. Some antimony oxides are to be seen in the back of the tunnel in a small cross-parting just beyond the winze. Between 20 and 25 tons of sorted ore is stacked at the portal of the tunnel. This showed considerable oxidation, some of which is undoubtedly recent as this ore has been exposed to the weather for several years. A chip sample of this ore assayed 40 percent antimony**.

A caved tunnel, situated 60 - 70 feet to the southwest, parallels the one just described, and another caved tunnel or cut occurs 125 feet distant in the same direction. On the hill above these tunnels there is a shaft filled with water.

No clean-cut, persistent, mineralized vein is to be seen in the accessible workings on either the Antimony or Applegate claim. In both places, judging from the size and shape of the winze stopes, the shoots have very short lateral extent compared to vertical extent. In neither place is there any obvious lead which would justify the presumption that lenses might repeat frequently along the strike of either of these shears. It would appear that structural control, such as the intersection of shears or joints, localizes mineralization. The fact that the inaccessible older workings are situated at uniformly spaced intervals at right angles to the strike of the main Applegate workings tends to substantiate this conclusion. However, it is reported that stibnite float has been found at many places on the hillside, and it is altogether probable that additional lenses may be found. Whether these are comparable in size to those already mined and equally widely separated, or whether larger ones more closely spaced and aligned occur, is problematical.

An analysis of the ore made by the Colorado Assaying Company, Denver, Colorado, and furnished by Mr. Lowry is as follows:

Moisture	0.50 %
Silica (true)	22.90
Iron oxide	2.30
Antimony	52.36
Sulphur	20.42
Calcium oxide	0.45
Aluminum oxide	0.60
Magnesium oxide	0.39
	99.89 %

DISTRICTS AND PROSPECTS

Antimony mineralization is rather widely distributed in some of the mining districts of Oregon. It occurs in the districts surrounding each of the mines just described with the exception of the Coyote mine on Cow Butte, Malheur County, which exists as a relatively isolated occurrence in a district in which there are few lode mines. But to a large extent, these antimony occurrences are in gold mines in which the antimony is a very minor constituent, or in which it is so intimately intermixed with sulphide minerals containing objectionable impurities that separation is not warranted. There are two known occurrences which rate as potential prospects, and, as is invariably the case where mineral deposits are concerned, there are several rumored prospects.

A list of the other occurrences, their locations, and references is given on page 16.

The two prospects mentioned above are the Hidden Treasure mine in Eastern Oregon and the El Capitan in Western Oregon. A brief description of these is as follows:

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* Treasher, R. C., State Department of Geology and Mineral Industries.
** Hoagland, L. L., idem.

HIDDEN TREASURE

General:

This property is located in the Virtue Flat district, Baker County, in sec. 10, T. 9 S., R. 41 E. It is owned by Mr. Hoff of Baker, Oregon, and is primarily a gold mine that has been worked intermittently from 1933 until recently. The mine is opened by an inclined shaft some 138 feet deep, sunk on an incline of 60 degrees. Several short levels run from this shaft.

Geology:

Both stibnite and antimony oxide are reported to occur as stringers and veinlets associated with the gold vein. Since the mine was not open for inspection the following quotation from a letter by Mr. Rombough*, the last operator of the mine, is given.

> "The Hidden Treasure . . .had stringers of valentinite, kermesite, and cervantite running through the quartz vein . . .The antimony would vary from a small stringer to one foot solid. The ore shoots were small, the longest about fifty feet (apparently referring to the precious metal shoots), With depth, and where the water was encountered, the Sb increased and the (gold) decreased." Also "The first car shipped ran a little over 5 percent Sb . . ." and "I don't believe we ever shipped a car that would go over 7 percent."

PRESIDENT OR EL CAPITAN MINE

General:

The President, or El Capitan, mine is situated in the Bohemia district; consists of 4 unpatented claims located in the E½ sec. 23, T. 23 S., R. 1 E.; and is owned by W. B. Patton of Culp Creek, Oregon.

These claims have been worked for gold and no production of antimony has been reported.

Geology:

This property was not examined by the writer. The following account of the development and geologic conditions prevailing there is quoted from a report by Allen**

> "The vein has been exposed by open cuts at intervals of 200 feet for over a thousand feet. There are two tunnels, the upper one is 83 feet above the lower and was caved when the property was visited. It is reported to be 160 feet long. The lower tunnel is 120 feet long, and strikes N. 70° W. In the lower tunnel the vein is from 15 to 30 inches in width and consists of two portions: the oxidized gold-bearing portion of the vein contains pyrite, chalcopyrite, galena, and sphalerite in a matrix of vuggy quartz breccia, with calcite crystals lining secondary cavities; and the stibnite-bearing portion consisting of blades and clusters of stibnite crystals in white silicified breccia. The former portion runs from 5 to 15 inches in width, the latter portion from 10 to 20 inches." . . ."At no place was the stibnite-bearing footwall definitely cross-out. About 10 tons of stibnite ore, which should contain at least 25% stibnite, lies on ths dump."

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*From a letter by Mr. Miles Rombough, dated Jan. 30, 1943, to Mr. H. K. Lancaster.
**Allen, John Eliot, State Department of Geology and Mineral Industries.

ADDITIONAL OCCURRENCES OF ANTIMONY

1. BUTLER CLAIMS	Sec. 2, T. 10 S., R. 33 E., New Eldorado district, Grant County. Reference: Parks and Swartley, Oregon Bureau of Mines and Geology, Mineral Resources of Oregon, Vol. 2, No. 4, p. 48, 1916.
2. E. B. REED CLAIMS (New Eldorado Mining and Reduction Company; Pioneer mine)	Sec. 7, T. 10 S., R. 34 E., New Eldorado district, Grant County. Reference: Parks and Swartley, Oregon Bureau of Mines and Geology, Mineral Resources of Oregon, Vol. 2, No. 4, p. 161, 1916.
3. RAND-HASKINS CLAIMS	Sec. 1, T. 9 S., R. 40 E., (about half a mile northwest of the Gray Eagle mine), Virtue district, Baker County. Reference: State Department of Geology and Mineral Industries, unpublished records.
4. SUNSET MINE	About 13 miles east of Baker on the Richland Highway, Virtue district, Baker County. Reference: State Department of Geology and Mineral Industries, unpublished records.
5. (UN-NAMED)	Sec. 35, T. 40 S., R. 4 W., (on Grouse Creek), Upper Applegate district, Jackson County. Reference: Winchell, A. N., Petrology and Mineral Resources of Jackson and Josephine Counties, Oregon; Oregon Bureau of Mines and Geology, Mineral Resources of Oregon, Vol. 1, No. 5, p. 129, 1914.

APPENDIX

INFORMATION CONCERNING PURCHASES OF SMALL LOTS OF DOMESTIC ANTIMONY ORES AND CONCENTRATES.

BY METALS RESERVE COMPANY

(Dated March 30, 1943)

Metals Reserve Company will purchase antimony ores and concentrates, containing twenty percent (20%) or more antimony, delivered to and unloaded at Purchase Depots, on the following basis:

Price: On ores and concentrates containing thirty percent (30%) antimony, Metals Reserve Company will pay One Dollar and Sixty-five Cents ($1.65) per dry short ton unit (20 pounds) of contained antimony. For each percent decrease in antimony content below thirty percent (30%) down to and including twenty percent (20%), a deduction of Five Cents ($.05) per dry short ton unit will be made from the above purchase price. Ores or concentrates containing less than twenty percent (20%) antimony will not be purchased under this Circular. For each percent increase in antimony content above thirty percent (30%) up to and including fifty percent (50%), an increase of One Cent ($.01) per dry short ton unit in the above purchase price will be made. For each percent increase in antimony content above fifty percent (50%), an additional increase of One and One-half Cents ($.015) per dry short ton unit in the above purchase price will be made for the antimony content above fifty percent (50%). All fractions to be prorated. Examples:

Antimony Assay	Price Paid for Dry Short Ton Unit of Antimony Metal
20%	$1.15
25%	1.40
30%	1.65
40%	1.75
50%	1.85
55%	1.925
60%	2.00
70%	2.15

No payment will be made for any metals other than antimony.

Quantity: Antimony ores and concentrates will be accepted at Purchase Depots in lots of not less than five (5) short tons (2,000 pounds avoirdupois). Total deliveries from any one mine during the calendar year 1944 cannot exceed 1,000 short tons, except in those cases where the seller has made special arrangements with Metals Reserve Company to accept quantities in excess of 1,000 short tons.

Rejection: Metals Reserve Company will not accept delivery at Purchase Depots of antimony ores or concentrates containing less than twenty percent (20%) antimony under this Circular.

The terms and provisions of this Circular will be effective until December 31, 1944.

BLOWPIPE TEST FOR ANTIMONY

Equipment necessary:

Agate mortar and pestle
Blowpipe
Alcohol burner
Charcoal blocks

Procedure:

Pulverize the material to be tested and place a small quantity in a shallow cavity at one end of the charcoal block. Heat strongly for a minute or more in the oxidizing flame (extreme tip), with the flame hitting the charcoal surface at a slight angle and directed along the length of the block.

If antimony is present, a white sublimate with a blue border will be deposited on the charcoal close to the assay. Frequently the assay will continue to give off fumes after heating has ceased.

Arsenic gives a white sublimate which is much more volatile than the antimony sublimate so that it forms some distance away from the assay, and is characterized by a strong garlic odor.

RHODAMINE B TEST FOR ANTIMONY *

Equipment necessary:

Agate mortar and pestle
Alcohol burner
Nickel or chrome wire
White porcelain spot plate
Two beakers and a watch glass
Filter paper

Chemicals necessary:

Rhodamine B
Potassium hydroxide
Potassium nitrite
Hydrochloric acid (dilute)
Water

Procedure:

Make up a 0.01 percent solution of rhodamine B reagent. This can be done by weighing out 10 mg of rhodamine B on a gold balance and adding water until the solution has a volume of 100 ml (cc's).

Pulverize the material to be tested and fuse with potassium hydroxide. This can be done by making a small loop (1/8-inch in diameter) on the end of the nickel or chrome wire and heating it with a small amount of potassium hydroxide in the loop until a bead is formed. While this bead is hot, dip it in the powdered sample and return to the flame until fused. Repeat the operation several times until a rounded bead is obtained.

Crush and dissolve this bead in a small amount (teaspoonful or slightly less) of water. Filter off the solution onto the spot plate.

Add 2 drops of hydrochloric acid and a pinch of potassium nitrite.

Then, on the addition of a few drops of the rhodamine B reagent solution in a 1:1 hydrochloric acid solution, the red color of the dye solution becomes violet in the presence of antimony.

---

* Adapted from Technical Methods of Ore Analysis, by Low, Weinig, and Schroeder.

PHOSPHOMOLYBDIC ACID TEST FOR ANTIMONY *

Equipment necessary:

- Agate mortar and pestle
- Alcohol burner
- Nickel or chrome wire
- A watch glass
- Filter paper

Chemicals necessary:

- Phosphomolybdic acid (5%)
- Potassium hydroxide
- Hydrochloric acid (dilute)
- Water

Make up a 5 percent solution of phosphomolybdic his can be done by weighing out 5 gm of phosphomolybdic acid on a gold balance, and adding water until the solution has a volume of 100 cc. Impregnate a piece of filter paper with this solution.

Proceed as in the rhodamine B test to the point where the fused bead is dissolved in water. Then place a drop of the test solution on the filter paper impregnated with phosphomolybdic acid and hold over steam. In a few minutes, if antimony is present, a blue coloration appears that is more or less intense according to the amount present.

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* Adapted from Spot Tests, by F. Feigl, page 58.

ANTIMONY MINERALS

Name	Composition	Approx. Percent Sb	Color	Hardness	Sp. G.	Habit
Stibnite	Sb_2S_3	72	Lead gray to steel gray (lead gray streak)	2	4.63	Usually aggregates, radiating crystals, disseminated.
Kermesite (Pyrestibnite)	Sb_2S_2O	75	Cherry red	1 - 1.5	4.68	Alteration of Sb_2S_3, usually tufts of capillary crystals.
Valentinite	Sb_2O_3	83	Colorless to white	2.5 - 3	5.76	Prismatic crystals and granular masses.
Senarmentite	Sb_2O_3	83	Colorless, grayish	2 - 2.5	5.50	Crusts and granular masses.
Cervantite	Sb_2O_4 ?	79	Yellow, white	4 - 5	6.64	Acicular crystals, also massive.
Stibiconite	$Sb_3O_6(OH)$?	76	Pale yellow to yellowish white	4 - 5.5	5.58	Amorphous, massive and compact.
Livingstonite	$HgSb_4S_7$	53	Lead gray (red streak)	2	5.00	Columnar to fibrous masses, interlaced needles.
Bindheimite	$Pb_2Sb_2O_8$	53	Black, gray, brownish to yellowish			Amorphous, earthy, incrusting.
Jamesonite	$Pb_4FeSb_6S_{11}$	33	Dark gray (streak grayish black)	2.5	5.63	Acicular crystals, in capillary forms; also compact, massive.
Bournonite	$PbCuSbS_3$	25	Steel gray to black (streak same)	2.5 - 3	5.83	Crystals, massive or granular.
Tetrahedrite	$(Cu,Fe)_{12}Sb_4S_{13}$	28	Flint gray to iron black (streak same, sometimes brown to cherry red)	3 - 4.5	4.6 - 5.1	Tetrahedral crystals, also massive or granular.
Famatinite	Cu_3SbS_4	28	Gray with tinge of copper red	3.5	4.52	Crusts of minute crystals, massive,granular to dense. Sometimes reniform.
Pyrargyrite	Ag_3SbS_3	22	Deep red (purplish-red streak)	2.5	5.85	Commonly prismatic crystals, also massive or granular.
Stephanite	Ag_5SbS_4	15	Color and streak iron black	2 - 2.5	6.25	Short prismatic crystals, also massive.
Polybasite	$(Ag,Cu)_{16}Sb_2S_{11}$	10	Iron black, cherry red in thin splinters (black streak)	2 - 3	6.1	Short six-sided tabular crystals with beveled edges; also massive.
Allementite	AsSb	62	Tin white or reddish gray	3 - 4	5.8 - 6.2	In reniform masses.
Native Antimony	Sb, sometimes containing As, Fe, or Ag	100	Tin white (streak same)	3 - 3.5	6.61 - 6.72	Generally massive and distinctly cleavable.

PUBLICATIONS

State Department of Geology and Mineral Industries, 702 Woodlark Building, Portland 5, Oregon.

BULLETINS

BULLETINS	Price Postpaid
1. Mining Laws of Oregon, 1942, rev. ed., contains Federal placer mining regulations	$0.20
2. Progress Report on Coos Bay Coal Field, 1938: F.W.Libbey	0.10
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13. First Biennial Report of the Department, 1937-1938	(out of print)
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