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BULLETIN 61

ANTIMONY DEPOSITS OF NEVADA

By

EDMOND F. LAWRENCE

MACKAY SCHOOL OF MINES
UNIVERSITY OF NEVADA

1963

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Reno, Nevada

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(Note: Assays of samples from individual occurrences in Nevada are given in text with descriptions of occurrences. Unless otherwise specified, all assays were made by the Nevada Mining Analytical Laboratory, Mackay School of Mines, University of Nevada.)

FOREWORD

Nevada has produced antimony since 1865, and often has led the United States in production of antimony ore. Each war boom has brought to Nevada a sudden influx of prospectors looking for antimony deposits.

Several surveys of the antimony resources of the western States and one study of selenium, associated with some epithermal ore deposits of the western States, have been made by the U. S. Geological Survey and the U. S. Bureau of Mines. Although these studies included Nevada, the information on the State was incomplete.

As a result of the increased demand for antimony during World War II and the Korean War, and because of the critical shortage after the Korean War of selenium, which occurs with antimony, it became apparent that, in order to be better able to meet similar emergencies in the future, it was necessary to determine the antimony resources of the State. Accordingly, in 1956 Edmond F. Lawrence, mining geologist with the Nevada Bureau of Mines, was given this assignment. The objective was to make a thorough study of all antimony occurrences in Nevada, and to determine if selenium was associated with any of the antimony deposits in economic amounts. Mr. Lawrence conducted his field and laboratory work from July 1956 to June 1961.

Toward the end of the field work, John H. Schilling, mining geologist with the Nevada Bureau of Mines, assisted in the field examination of some of the deposits. Using Mr. Lawrence's field notes and maps, Mr. Schilling contributed greatly to the bulletin by directing the preparation of the illustrations and writing the descriptions of the deposits included in the report. Also, Mr. Schilling rendered valued assistance by revising and reorganizing the introductory portion of the report.

This bulletin presents a complete record of the antimony resources of Nevada. Some of the deposits described could be brought quickly into production if our country faced another war emergency. The report should be of great value to industry engaged in the production or use of antimony.

VERNON E. SCHEID, *Director*
Nevada Bureau of Mines

May 1963
Mackay School of Mines
University of Nevada

ANTIMONY DEPOSITS IN NEVADA

By Edmond F. Lawrence

ABSTRACT

Antimony ore was discovered in Nevada in the early 1860's and has since been mined sporadically in 12 of the State's 17 counties. Although numerous shipments were made in the 1870's and 1880's, most subsequent production has come during wartime, when prices have risen because of reduced imports. Only small amounts of antimony have been produced from Nevada mines in recent years.

Based on past Nevada production and economics, it is concluded that the common narrow vein deposits necessitate high-cost underground mining methods. High labor costs, lack of water, and distance from markets are further disadvantages. Most future antimony mining may come from exploitation of large low-grade deposits by open-pit methods.

Antimony occurs in 15 counties. Chief production has been from Pershing, Churchill, and Lander Counties, with minor production from Nye, Mineral, and Esmeralda Counties. Antimony was the only metal recovered at some mines; some was produced from what are primarily gold, silver, and base-metal mines. Of 184 occurrences listed, 41 have produced more than 10 tons of metallic antimony and 3 have produced more than 1,000 tons each.

Most producing mines are in or near limestone beds. Other wall-rock types include calcareous shale, rhyolitic flows, sandstone, and granitic rocks. Ore bodies usually occur as fissure veins, and occasionally as replacement deposits or as disseminations in silicified zones. Wall-rock alteration is varied, but silicification and sericitization are common. Stibnite is the major ore mineral, but minor production has come from jamesonite and from antimony oxides, primarily stibiconite and bindheimite. Nonproducing mineral occurrences include tetrahedrite and other complex sulfides and sulfosalts. The antimony minerals are commonly associated with pyrite, base-metal sulfides, cinnabar, and scheelite.

Antimony mineralization sometimes occurs in a zonal pattern, often on fringes of gold, tungsten, mercury, or base-metal mining districts. Although usually epithermal in character, antimony sometimes appears as aureoles around base-metal deposits, but rarely occurs with scheelite. The investigation revealed only traces of selenium associated with antimony.

INTRODUCTION

PURPOSE AND SCOPE

Nevada has for many years accounted for a small but significant percentage of the total antimony production of the United States. Antimony has been the principal metal produced at many mines, and has been extracted as a by-product at many others. This study attempts to describe all significant antimony mines, prospects, and occurrences in the State. The widespread occurrences, mostly of minor economic importance, that were found to contain only tetrahedrite or the antimony oxysulfides were too numerous to mention individually. While major emphasis has been placed on the location, geology, and mineralogy of the deposits, much information concerning their history, development, and production has been included.

PREVIOUS WORK

As the result of increasing demand for antimony during World War I, Frank L. Hess of the U. S. Geological Survey prepared a report on the antimony deposits of the United States. This report, expanded by F. G. Schrader in 1923 following additional field work, was never published.

With the increase in demand during World War II, Donald E. White of the U. S. Geological Survey examined and wrote reports on numerous antimony deposits.

In 1951 the U. S. Bureau of Mines, in cooperation with the U. S. Geological Survey, published a report on the antimony resources of the United States for the National Security Resources Board.

The U. S. Bureau of Mines in 1956 obtained the extensive files of Fred H. Dakin, ore buyer of Burlingame, California, and from them a report on antimony in California and Nevada was prepared by Q. A. Aune, but was not published.

METHOD OF INVESTIGATION

The present study was begun in 1956 with an investigation of previously recorded information, both published and unpublished, describing antimony production and mineralization in Nevada. All known occurrences were then examined systematically. Conversations with the holders of many of these properties led in turn to knowledge of additional mines and prospects in adjacent areas. All reported occurrences of significant antimony mineralization in the State were investigated ultimately, excepting only the numerous occurrences, both in existing mines and elsewhere, of tetrahedrite and the antimony oxysulfides.

An attempt was made to gain access to all workings, and geologic mapping and sampling were done in all accessible workings that appeared to contain significant indications of antimony mineralization. The geologic mapping was accomplished with the aid of either Brunton compass and tape or plane table. All samples were examined under a binocular microscope. Portions of the samples were assayed for antimony, and selected samples were assayed also for gold, silver, selenium, and other elements. Thin sections, and polished sections of selected samples, were made and examined to determine further the relationship and proportions of the minerals present. Finally, X-ray techniques were used in some of the most difficult mineral determinations.

ACKNOWLEDGMENTS

The author expresses his sincere thanks to the numerous mine owners, mine operators, prospectors, ranchers, and others who rendered valuable assistance by furnishing information concerning the various prospects described in this report. Many of these people spent time in the field with the writer. Joe Neil, Lee Hand, William Baker, Vicente Bilbao, Earl Phillips, Alma Priester, Howard Turley, Jim Tow, Frank Fullstone, Fred Gilbert, Carl Sullivan, Fred De Longchamps, Fred Dakin, W. B. Young, Robert Knight, Josie Pearl, Claude Gardner, Robert Prunty, Fred S. Gribble, Louis Kattenhorn, Marion Fisher, Madison Lockes, John Titus, George Peterson, E. J. Bottomley, Mac Butts, Louis Martin, Link J. Nickelson, Sue Magee Gamble, William Sizemone, N. R. Maxwell, Ted Stevens, James Sisck, Anna F. Rechel, Warren B. Richardson, Charles Milan, June Babcock, Magnus F. and Lorina Peterson, gave materially of their time and help.

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The author would also like to take this opportunity to thank his colleagues at the Mackay School of Mines, Nevada Bureau of Mines, and Nevada Mining Analytical Laboratory for their cooperation and helpful suggestions, and especially Alexis Volborth, Harold Vincent, and Paul Weyler for the analytical work, and John S. Winston for his help in the X-ray identification of the antimony minerals. Mrs. Barbara Webb has done an excellent job of drafting the maps.

John H. Schilling worked closely with the author in preparation of the mine, prospect, and occurrence descriptions, and also in preparation of the illustrations. His help and advice are especially appreciated.

Special thanks are due the several field assistants, namely Donald C. Divans, Paul Hauser, Eugene Nazarek, and John Middlebrook, who worked long hours under difficult conditions without complaint.

PROPERTIES AND USES OF ANTIMONY

Antimony is a brittle, silver-white metal with a specific gravity of 6.6 and a melting point of 630.5° C., and is similar in many chemical and physical properties to arsenic and bismuth. It occurs in two allotropic forms, metastable (explosive) alpha and beta (black) antimony.

Although antimony is produced in only minor quantities when compared to the base metals, it has many diversified uses in both peacetime and war.

Antimony is almost never used as an unalloyed metal except in the making of ornamental castings. It has been put to a wide variety of uses in alloys, primarily because of two physical properties. It acts as a stiffener and hardening agent when added to lead in small quantities, thereby making the lead, or rather the lead-antimony alloy, available for a great variety of uses that could not be satisfied by pure lead alone. A second property of antimony, unique among the common metals, is that it expands upon cooling. When added in proper proportions to lead and other metals, it makes possible the creation of alloys that do not change size on cooling. Chemical compounds of the metal also have been adapted to a variety of uses.

There are three major uses of antimony. The largest single use (35 percent) in the United States is as a stiffener in the lead grids of automobile *storage batteries*. The antimonial lead used in batteries contains from 5 to 11 percent antimony. *Antifriction bearings* are made of two types of alloys: tin-base alloys, often known as "Babbitt metal," which contain less than 10 percent antimony; and lead-base or white metal alloys which contain up to 15 percent antimony. *Type metal* used in casting type slugs for all letterpress printing processes, is composed of lead, tin, and up to 30 percent antimony. Although a great quantity of antimony is used for this purpose, practically all type metal is reclaimed for continued use, thus the consumption of new metal is quite low.

Antimony is used to a lesser extent in a great variety of articles. Antimony oxide has found widespread use as a stabilizer and flame-retardant in the manufacture of many common *plastics*. *Pigments* of many colors are made from antimony and its compounds. These pigments include: "antimony black," which is finely powdered antimony metal; "antimony white," the trioxide; "antimony vermilion," the red trisulfide; and "antimony yellow," which is produced by the slow oxidation of the sulfide. The chloride and trioxide of antimony are used as *fire-retardants* and flameproofing agents, and the sulfides in *primers* for both military and sporting cartridges.

EXTRACTIVE METALLURGY

Hand sorting and cobbing of antimony ore has been the general practice both in foreign mines and in Nevada; screens also have been used with some success. Flotation is used by the larger producers, such as at Yellow Pine, Idaho (Bradley, 1942), but flotation of oxide ores has not been successful, and hand sorting and jigging have been used to upgrade these ores.

A description of the production of antimony compounds and metal from its ores and concentrates is beyond the scope of this bulletin. Possibly the most comprehensive discussion is that given by Wang (1952); other references include Renick (1956), Goldman (1957), and White (1951). The recovery of stibnite and mercury from cinnabar-stibnite ores has been described by Erspamer and Wells (1956) and Wells and others (1958). Newton and Wilde (1949) have discussed the production of antimony oxide.

ECONOMICS OF ANTIMONY

WORLD PRODUCTION AND CONSUMPTION

The world production of primary antimony has varied from a low of 17,000 tons to an all-time high of 90,000 tons in 1916. It reached 59,000 tons during World War II. From 1925 to 1949 the output averaged 37,500 tons; during this period China produced 32 percent, Bolivia 20 percent, and Mexico 18 percent, the United States and Czechoslovakia 4 percent each, Yugoslavia and Peru 2 percent each, and other countries the balance (White, 1951, p.

V–3). China probably has the world's largest reserves, estimated at over 5,000,000 tons. Bolivia and Mexico also have large reserves that can be worked cheaply. The United States and a number of other countries have deposits that can be worked when prices are high.

The largest users are those nations most advanced industrially. In 1948, the United States and Great Britain consumed 48 percent of the world production of antimony while producing approximately 4 percent. The U.S.S.R. is dependent on ore from China.

UNITED STATES PRODUCTION AND CONSUMPTION

Although the United States is the world's largest consumer of antimony, it has never been a major producer of ore (table 1). In 1958 it consumed 11,880 tons of primary antimony of which only 705 tons were mined domestically; and it consumed the entire 19,200 tons of secondary antimony recovered.

Imports were supplied principally by China until 1937, after which the United States received most of its imports from Bolivia and Mexico. Domestic primary ore has been relatively unimportant except during periods of war and high prices. The Yellow Pine mine (closed since 1952) in Idaho has produced 90 percent of all domestic ore. The supply from both domestic and foreign antimonial lead ores is diminishing. Our total exports of antimony have never been over 1,000 tons, and averaged 392 tons over a 25-year period.

Wars have brought an increase in the domestic and world consumption of antimony. However, in wartime much of the material containing antimony is lost, and secondary production lags behind, usually amounting to only a third of the total amount consumed.

Prices have varied from a low of 5 cents a pound in 1932, to a high of 44.17 cents a pound in 1951, and have varied greatly even within a one-year period. Availability of foreign ore has been the principal criterion of price, along with local demands and available stocks. The uncertainty of prices has discouraged extensive exploration for antimony.

NEVADA PRODUCTION

Antimony was first reported in Nevada in the early 1860's, and since that time has been found in every county except Ormsby and Storey. Shipments have been made from all counties except Clark, Lincoln, Lyon, Ormsby, and Storey. The first smelter in Nevada, a Stetefeldt-type furnace, was erected along the Humboldt River at Oreana in 1865 to treat the antimonial silver ores of the Arabia district; it was destroyed by fire several years later.

Shipments of antimony ore were made from the Apex mine in the Battle Mountain district in Lander County in the 1870's. Whitehill (1875, p. 49) reported the discovery of antimony in Jackson Canyon near Unionville, and wrote that it had been worked by Campbell in 1870. The Sutherland mine near Lovelock was operated in 1883–1884, and the Cottonwood Canyon mine produced several hundred tons of antimony ore before 1883. The ore was concentrated in a small mill at Battle Mountain and shipped either to New York or San Francisco. George Star produced 150 tons of high-grade oxide in a crude furnace at the mine in 1884.

Antimony was discovered in the Bernice Canyon district by H. Hoyt in 1885, and subsequently worked by Hoyt and John Williams, with the first antimony produced in 1892. This shipment was sent to the Star and Mathews Smelter in San Francisco by W. W. Van Reed. Some ore was shipped from 1893 to 1896. The Bray-Beulah, Hard Luck-Pradier, and Dry Canyon mines in the Big Creek district near Austin were discovered in 1890–1891, and ore was produced. Becker (1888, p. 343) described the occurrence of "metastibnite" and stibnite at Steamboat Springs, near Reno.

World War I brought a revival of interest in antimony in Nevada, and considerable work was done prospecting for new deposits and exploiting known deposits. The Blue Dick, Cottonwood Canyon, Antimony King, Bray-Beulah, Dry Canyon, Sutherland, Hollywood, Bloody Canyon, Burns Basin, Volcanic Peak, Last Chance, Hot Creek, and White Caps mines were active, along with many small prospects that shipped only a few tons. World War II and the Korean War again created new interest in antimony production. The Metals Reserve Company set up ore-buying stations at Winnemucca and Battle Mountain for buying small lots of ore. The Last Chance, Antimonial, Milton Canyon, Merrimac, Enterprise, Burns Basin, Choates, Bernice Canyon, W. P., Nevada King, Apex, S. P., Cottonwood Canyon, Hollywood, Blue Dick, Antimony King, Hard Luck-Pradier, Sutherland, Adriene, and others produced large shipments, while smaller shipments were consolidated at the Metals Reserve stockpiles at Winnemucca and Battle Mountain.

Since 1952 some antimony has been produced from the Big Creek district, Bernice Canyon area, Danite, Enterprise, Merrimac, Lithia, Potosi, Antimony Lode, Last Chance, and White Caps mines. Ted Stevens operated a flotation mill at Austin for ore from the Big Creek district, and also custom ore from the Last

Chance, Antimony Lode, and White Caps mines. The Metallurgical Development Company operated a mill near Gardnerville for ore from the Danite mine. John Heizer milled some antimony ore at the Toulon mill, 16 miles southwest of Lovelock. The Nokai Dome Company operated a small oxide plant in the Taylor district in 1960. The oxide plant at the Last Chance mine was dismantled in 1957.

Total production figures for each year are impossible to obtain but the following data are significant. In 1941, 16 operations produced 691 tons of ore containing 146 tons of antimony; in 1942, 11 operations produced 305 tons of ore containing 96 tons of antimony; in 1943, 84 tons of ore were produced containing 32 tons of antimony; in 1944, 5 operations produced 74 tons of ore containing 30 tons of antimony; and in 1945, 3 operations produced 65 tons of ore containing 32 tons of antimony.

ANTIMONY MARKETS AND OUTLOOK

The antimony market in the United States is probably more variable than that of any other mineral commodity. The dependence upon imports of ore makes a very unstable market for domestic producers; they are at the mercy of foreign sources. Because of availability of foreign ore varies from day to day, importers hesitate to make firm commitments to domestic producers. However, in 1961, there appeared to be a strengthening of the local markets by domestic smelters. Freight rates were lowered to offer more inducement for domestic ore production. In 1962 there were some negotiations in progress for domestic production of antimony ores for export to Japan. This may indicate some hope for the domestic producers.

A 1961 quotation on antimony oxide ore was 10.25 cents per pound of contained antimony for ore containing 40 percent or more antimony, F.O.B. Laredo, Texas. Ore above 40 percent brings an increase in price of 1 cent a short ton unit for each increase of 1 percent in antimony content. The maximum impurities are: arsenic and copper, 0.1 percent; lead, 0.1 percent; and zinc, 0.5 percent. In 1962 the price for sulfide ore delivered at Laredo, Texas, was 12 cents per pound of contained antimony for 60 percent ore. The freight rate to Laredo was $18.25 a ton for a carload lot of 50 tons.

The price of antimony must reach about 40 cents a pound or more before most of the antimony prospects and mines in Nevada could be developed. High labor cost, lack of transportation, lack of water, distance from market, and other factors make antimony mining in Nevada a high-cost operation. Since most of the deposits have narrow veins that necessitate underground mining, it is not conceivable that these mines could operate except at a high price per pound. However several antimony mines in Nevada may be worthy of further exploration to determine the possibility of large low-grade deposits that could be operated as open pits, or by other low-cost mining methods. In case of another national emergency undoubtedly more antimony could be developed at a number of the prospects described in this report.

GENERAL GEOLOGY OF ANTIMONY DEPOSITS

OCCURRENCE

Antimony occurs throughout the world in a variety of deposits. These include epithermal veins, replacement, hot-spring, and pegmatite deposits. Antimony has been found in rocks from Precambrian to Quaternary in age; in sedimentary, granitic, and volcanic rocks; and in rocks deposited by hot springs. Usually the deposits are shallow; however, they have been mined to depths of 600 to 800 feet. The reader is referred to Wang (1952, p. 1–34) and White (1951) for an outline of the geology of the antimony deposits of the world.

The epithermal deposits are usually in quartz or calcite veins, which are commonly narrow and vuggy. Beautiful crystals of stibnite up to 24 inches long have been found in vugs in quartz veins in Ichinokowa, Shikohu Island, Japan; Peneta, Tuscany, Italy; Coyote Creek, Idaho; and Manhattan, Nevada, as well as many other places. Although usually granular and prismatic, some of the stibnite is so fine grained that it breaks with a conchoidal fracture. Other sulfides often occur with the stibnite; however, commonly it is the only sulfide in the vein.

Replacement deposits in shales and limestones are common throughout the world, especially in Yugoslavia, China, Japan, and Algeria.

Antimony commonly is associated with gold and silver deposits, sometimes in a spatial rather than genetic association. Antimony appears to be more closely associated with gold when it occurs as stibnite, and with silver when it occurs in sulfantimonides. Stibnite occurs with gold at Queensland, Australia; South Africa; Alaska; Czechoslovakia; and at Stibnite, Idaho. In Nevada it is associated with the high-grade gold in the National and Manhattan districts.

MINERALOGY

According to Mason (1952, p. 41), antimony is the fifty-eighth most abundant element in the earth's crust, averaging one part per million. It occurs in over a hundred minerals, the most important of which are listed in table 2. The only sulfide is stibnite, which is the most common antimony mineral, and the most abundant ore. The oxides, senarmontite, valentinite, stibiconite, kermesite, and bindheimite, are next in importance as ores of antimony. Jamesonite is important as an ore mineral at Zimapán, Hidalgo, Mexico; Candelaria, Nevada; and the Arabia district, Nevada. Bindheimite and tetrahedrite also have been important sources of antimony. Native antimony has been found in many places, including the Oreana pegmatites in Nevada.

TABLE 2

Chemical Formulas, crystal habit, and antimony content of the most common antimony minerals[1]

	Formula	Crystal Form	Antimony content (percent)
Stibnite	Sb_2S_3	Orthorhombic	71.7
*Senarmontite	Sb_2O_3	Cubic	83.3
*Valentinite	Sb_2O_3	Orthorhombic	83.3
*Stibiconite	$(Sb^{3+}, Ca)_ySb_{2-x}(O, OH, H_2O)_{6-7}$	Cubic	74.5
*Bindheimite	$Pb_ySb_{2-x}(O, OH, H_2O)_{6-7}$	Cubic	11.4
*Stetefeldite	$Ag_ySb_{2-x}(O, OH, H_2O)_{6-7}$	Cubic	17.3
*Partzite	$Cu_ySb_{2-x}(O, OH, H_2O)_{6-7}$	Cubic	.....
*Tripuhyite	$Fe_{1-y}Sb_{1-x}(O, OH)_4$	Tetragonal	26.4
*Bystromite	$Mg_{1-y}Sb_{2-x}(O, OH)_6$	Tetragonal	.....
Kermesite	Sb_2S_2O	Monoclinic	75.0
Native Antimony	Sb	Monoclinic	100.0
Jamesonite	$Pb_4FeSb_6S_{14}$	Monoclinic	33.4
Tetrahedrite	$(Cu, Fe)_{12}Sb_4S_{13}$	Monoclinic	28.0
Livingstonite	$HgSb_4S_7$	Monoclinic	53.0
Dyscrasite	Ag_3Sb	Orthorhombic	25.0
Polybasite	$(Ag, Cu)_{16}Sb_2S_{11}$	Monoclinic	8.0
Stephanite	Ag_5SbS_4	Orthorhombic	15.5
Pyrargyrite	Ag_3SbS_3	Hexagonal	22.5
Geocronite	$Pb_5(Sb, As)_2S_8$	Orthorhombic	8.0
Bournonite	$PbCuSbS_3$	Orthorhombic	24.9
Berthierite	$FeSb_2S_4$	Orthorhombic	56.6
Meneghinite	$Pb_{13}Sb_7S_{23}$	Orthorhombic	19.9
Boulangerite	$Pb_5Sb_4S_{11}$	Monoclinic	29.5
Zinkenite	$Pb_6Sb_{14}S_{27}$	Hexagonal	44.7
Diaphorite	$Pb_2Ag_3Sb_3S_8$	Orthorhombic	26.8
Andorite	$PbAgSb_3S_6$	Orthorhombic	41.9
Robinsonite[2]	$7PbS \cdot 6Sb_2S_3$	Triclinic	27.4

[1]Data for above minerals taken from Palache and others (1951), except those with an asterisk (*), which were taken from Mason and Vitaliano (1953, p. 111).
[2]Robinsonite, although not a common mineral, was included because the only reported occurrences, first described by Berry and others (1952), have been from the Antelope Springs district, Nevada.

The oxidation products of the antimony sulfides and sulfosalts have not been well understood until recently when Vitaliano and Mason (1952, 1953) did considerable research on the mineralogy of the antimony oxides and antimonates. Previous to

1952 the mineralogy textbooks listed cervantite, stibiconite, senarmontite, and valentinite as the antimony oxide minerals. Senarmontite and valentinite are polymorphs of Sb_2O_3, and were well defined by Vitaliano and Mason (1952, 1953), who concluded that, except for valentinite and senarmontite, the only antimony oxide mineral is a solid solution which is either cubic with a pyrochlore structure or tetragonal with a trirutile structure. Because of defect lattices, the chemical composition and physical and optical properties are quite variable within species. Vitaliano and Mason (1953, p. 111) recognize the following antimony oxide minerals: senarmontite, valentinite, stibiconite, bindheimite, stetefeldite, partzite, tripuhyite, bystromite.

The term stibiconite was introduced by F. S. Beudant in 1832 for an antimony ocher containing water, and in 1850 J. D. Dana used the term cervantite to describe a water-free antimony ocher from Cervantes, Spain. Cervantite and stibiconite are synonymous, and the term stibiconite, having priority, should be used.

The following mineral names of antimony oxides are now obsolete: cervantite, hydroromeite, stibianite, volgerite, arsenostibnite, rivotite, barcenite, stibioferrite, atopite, schneebergite, weslienite, mauzelite, lewisite, coronquite, arequipite, and flajolotite. Oxidation of stibiconite and the various antimony sulfosalts is not understood. Kermesite appears to be the first oxidation product, occurring as thin films along cleavages and fracture planes. Further oxidation changes it to one of the antimony oxides. Color is not significant in identifying the oxides as both yellow and white oxides have been determined by X-ray to be stibiconite.

NEVADA DEPOSITS

GEOGRAPHIC DISTRIBUTION

This study describes 184 occurrences of antimony mineralization in Nevada, distributed among 15 of the State's 17 counties (pl. 1). While ore shipments have been made from 12 counties, the principal productive areas have been north of the 38th parallel, mainly in Pershing, Churchill, and Lander Counties.

There are numerous small deposits and several large deposits in northern Nye County, and in Mineral and Esmeralda Counties. The Potosi mine at Candelaria, one of the larger deposits, contains antimony mineralization associated with lead and silver, while in the Manhattan area antimony is associated with gold, arsenic, and mercury. The southern Toiyabe Range is the site of several large antimony deposits.

The principal mines occur in a northwest-trending belt extending from southern Lander County to the Trinity-Humboldt area in Pershing County. A second belt or zone of antimony mineralization extends northeastward from Mineral County to western Elko County. These so-called "belts" may be fortuitous, but they coincide with other mineral belts in the State.

The most productive antimony deposits are clustered in several areas of five counties; around the northern end of the Clan Alpine Range in Churchill County, the Big Creek area in the northern Toiyabe Range in Nye County, the Humboldt Range in Pershing County, the Antler Peak area in southern Lander County, and along the Independence Range in Elko County. The clusters in the Humboldt Range and the Antler Peak area probably represent a rough zoning around centers of extensive mineralization.

ZONAL RELATIONSHIP TO OTHER DEPOSITS

The antimony deposits in Nevada quite often occur along the fringes of mining districts, and in some areas appear to occur in a zonal pattern. This is especially true in the Humboldt Range in Pershing County and in the Battle Mountain district in Lander County.

In the Humboldt Range, antimony in the form of either stibnite or tetrahedrite, has been found along the flanks of the mountains from the Antelope Springs district, along the western flanks, to the Unionville area on the eastern flank (see pl. 1). Several of these deposits are actually in the northern end of the West Humboldt Range, north of Coal Canyon. The Arabia and Trinity districts lie just to the west of the western flank. Stibnite has the same spatial relationship to the country rock and dikes all along the western flank of the range. The deposits in the Bloody Canyon, Star Canyon, and Unionville areas are quite similar. The Hollywood and Sutherland mines along the southern flank are similar and appear to occur in a zonal pattern with cinnabar. A detailed study of this area has recently been completed (Eidel, 1963). This gross relationship is evident in many of the detailed descriptions of the mines, prospects, and other occurrences.

A similar pattern appears to exist in the Battle Mountain mining district where antimony mineralization is spatially related to the copper-lead-zinc-gold-silver deposits. An indication of this same relationship has been noted in several other areas.

WALL ROCK

A study of the antimony deposits has shown a clear relationship between the degree of mineralization and the lithology of the host rock. Most of the producing mines are either in or near limestone or calcareous shale. Two of the four mines with the largest production (more than 500 tons of antimony metal) are in calcareous shales, one in interbedded shale and volcanic rock, and the other in a sequence of rhyolitic flow rocks near a limestone contact. Of the 11 mines with production of between 100 and 500 tons of antimony, 4 are in limestone, 3 in shale, 2 in rhyolitic flows, and 1 each in sandstone and granodiorite. These 15 mines (pl. 1) account for the bulk of the total antimony production of the State.

Of the 184 occurrences described in this report, 56 are in or near limestone beds, 39 are associated with shales or shaley rocks, 30 are in sandstones and quartzites, 17 are in intrusive rocks ranging from granite to diorite, 26 are in fine-grained volcanic rocks ranging in composition from rhyolite to andesite, and at least 15 are closely associated with dikes of latitic to diabasic composition. Twelve other occurrences are located near dikes.

MINERALOGY

Although many antimony-bearing minerals have been found in Nevada, most have been found only in small quantities, commonly as alteration products of the primary sulfides. Others are complex minerals containing antimony in association with lead, copper, silver, and other metals.

Stibnite is the most common antimony mineral found in Nevada, having been found in most of the deposits described in this report. Jamesonite and its alteration product bindheimite have been found in several localities, including the Arabia district, the Bottomley, Green Antimony (Pershing County), Green prospect (Churchill County), Lowman, Potosi, Rochester, Iron Pot, Nevada-Massachusetts, and several mercury mines in the Antelope Springs and Pilot Mountain districts. Beautiful specimens of bindheimite after jamesonite have come from the Potosi mine at Candelaria. Here veins up to 12 feet wide containing jamesonite have been almost completely replaced by bindheimite. Antimony also occurs in tetrahedrite, andorite, stephanite, pyrargyrite, polybasite, proustite, and other sulfantimonides in many of the mining districts of Nevada, but usually has not been recovered. Tetrahedrite was the antimony mineral in 13 deposits and occurred with stibnite in 10 other deposits. Valentinite and stibiconite have been important in several of the prospects as ore minerals. Senarmontite was found in one deposit.

Pyrite, galena, sphalerite, chalcopyrite, argentite, gold, arsenopyrite, scheelite, cinnabar, and barite are spatially or genetically associated with the antimony minerals in Nevada in varying amounts. The stibnite generally is older than these associated minerals. Pyrite is the most common mineral associate of stibnite, having been found in most of the mines. Arsenopyrite was found in 19 of the occurrences described, but usually only as occasional grains. Galena and sphalerite were found in 11 of the occurrences, while sphalerite without galena was found in 3 deposits, and galena without sphalerite in 4 deposits. Chalcopyrite was noted as scattered grains in 5 deposits. Cinnabar occurred in varying amounts in the antimony ores in 18 deposits, of which 13 had produced mercury. Eleven deposits are associated spatially with scheelite, and several of these appear to be genetically related. Barite was a principal gangue mineral in 10 deposits. Some of the barite enclosed crystals of stibnite. Quartz was the principal gangue mineral in 100 of the deposits, while calcite was the principal gangue mineral in 7 and occurred in significant amounts in 34 others.

In most of the mines that have produced, antimony occurs in fissure veins, with quartz as the principal gangue mineral, although in several of the deposits stibnite occurs disseminated in the silicified wall rock. Ninety-four of the deposits described are definite veins; 15 are disseminated deposits. Calcite is the principal gangue mineral in only one of these deposits, while barite is common in two of them. Pyrite, arsenopyrite, sphalerite, galena, tetrahedrite, and gold are found associated with the larger deposits more often than with the minor occurrences, indicating a more intense mineralization.

SELENIUM ASSOCIATED WITH ANTIMONY

Because selenium has often been associated with antimony mineralization, an attempt was made in the present study to check all Nevada antimony occurrences for selenium content. All polished sections were checked for the presence of selenium minerals but none was found. Eighty-seven samples were chemically analyzed for selenium by the Nevada Mining Analytical Laboratory, and approximately 60 additional samples were analyzed at the laboratory of the U. S. Geological Survey, Denver, Colorado. Table 3 lists the selenium and antimony content of all samples which were found to contain any selenium.

Of these analyses only nine samples from four mines contained as much as 0.1 percent selenium. Samples from the Green prospect in Churchill County ran 0.29, 0.90, 1.6, and 3.0 percent. However, this material is bindheimite and native sulfur that has oxidized from jamesonite(?), and occurs as boulders in rubble recemented by Lake Lahontan tufa. The King Solomon mine was drilled during an exploration program for selenium, but no commercial deposits were found. Three samples from this mine assayed 0.15, 0.00, and 0.10 percent selenium. Samples from the Kattenhorn mine ran 0.27, 0.12, and 0.10 percent selenium. These samples came from the area containing stibnite, although the mine was principally a silver producer.

While this study was in progress, the U. S. Geological Survey published a report (Davidson, 1960) giving the results of a study of the selenium content of some epithermal antimony, mercury, silver, and gold deposits. The Nevada samples analyzed were among a group of 52 samples previously collected by Fred Dakin. They ranged from a trace to 1.06 percent in selenium content; only 11 contained as much as 0.1 percent of selenium.

From the data collected by both Davidson (1960) and the author, it appears that the chances of finding a commercial selenium deposit in association with antimony in Nevada are small. Further work in the volcanic rocks might change this outlook.

ALTERATION

Wall-rock alteration is quite variable from one deposit to the other. In most of the antimony deposits the wall rock is argillized, and in several of the occurrences it has been almost completely sericitized. Silicification of the wall rock, especially limestone, is common. In some deposits it has been altered for only a few inches away from the vein, while in others there is extensive alteration, apparently grading from argillization to sericitization, with some silicification. In a few of the deposits associated with limestone, large areas have been silicified. These usually contain stibnite disseminated throughout the silicified zone. The intensity of alteration appears to be greater in deposits associated with other sulfides.

TABLE 3. Selenium content of selected samples from Nevada antimony occurrences

Mine	Project sample No.	Sample description	Selenium content (percent)	Antimony content (percent)
Churchill County				
Marguerite	150	Stibnite in vein material	Tr.	6.48
Green	156	Stibnite boulder	0.29	50.62
	*156B	do	0.9	
			1.6	
			3.0	
Hazel	157	Stibnite, grab sample from dump	0.044	3.81
Elko County				
Prunty Antimony	50	Stibnite in vein material	0.018	0.26
	*50B	Stibnite in vein material from dump	0.006	
Esmeralda County				
Mickspot	211	Stibnite ore from dump	Tr.	35.14
	213	do	Tr.	0.6
Eureka County				
Blue Eagle	216	Stibnite in 12-inch vein	Tr.	16.10
	217	Stibnite, vein material	Tr.	38.92
Humboldt County				
National (Bankers shaft)	134	Stibnite in vein material from dump	Tr.	4.36
Lander County				
Cottonwood Canyon	136	Stibnite, vein material	Tr.	1.79
Weber	146	Stibnite, grab sample	Tr.	1.00
Blue Dick	145	do	0.04	51.77
	*145B	Stibnite, vein material from dump	0.15	
Blue Nose	189	do	Tr.	1.00
Kattenhorn	143	Stibnite, vein material	0.10	15.92
	144	do	0.13	20.65
	186	Stibnite, 16-inch vein	Tr.	0.60
	*143B	Stibnite in vein material	0.12	
	*144B	do	0.27	
Antimony King	184	Stibnite from ore bin	Tr.	4.79
Bray-Beulah	185	Stibnite from small stockpile	0.005	34.04
	*185B	Stibnite in vein material on dump	0.02	
Dry Canyon	187	do	Tr.	6.34
	188	do	Tr.	4.64

Mineral County				
Potosi	169	Bindheimite, 300-foot level, east stope	0.018	32.70
Hartwick	219	Stibnite in vein material from dump	Tr.	4.64
Nye County				
Antimonial	172	Stibnite, 14-inch vein	0.014	37.12
	*172B		0.04	
Page	174	Stibnite, 4-inch vein	0.010	16.53
Milton Canyon	176	Stibnite, 8-inch vein	Tr.	20.77
Blackbird	177	Stibnite, 2-inch vein	0.040	12.59
	206	Stibnite, 8-inch vein	0.005	7.69
King Solomon	195	Stibnite in small stockpile	0.10	38.86
	*195B	do	0.15	
Flower	198	do	Tr.	18.60
Dollar	201	Stibnite ore	0.005	40.63
	*201B	do	0.05	
Lucky Tramp	202	Stibnite, 4-inch vein	Tr	32.09
Teichert	203	Stibnite, tetrahedrite, galena, sphalerite ore	Tr.	1.30
	204	do	Tr.	Tr.
Last Chance	207	Stibnite in vein material from dump	0.005	35.50
	208	Stibnite from ore bin	0.005	4.15
	209	Stibnite in vein material from dump	0.005	5.49
Pershing County				
Electric	83	Bindheimite and stibiconite, 8-inch vein	0.01	1.00
	84	Bindheimite and stibiconite, 15-inch vein	Tr.	4.16
	85	Bindheimite and stibiconite	Tr.	5.94
West Group	88	Stibiconite in 12-inch vein	0.022	2.52
Montezuma	94	Stibiconite in 24-inch vein	Tr.	None
Pflum	98	Stibnite and tetrahedrite	0.006	11.30
	221	Stibnite and tetrahedrite, 8-inch vein	0.005	9.88
Fencemaker	155	Stibnite in 3-inch vein	Tr.	3.03

*Analyses by the Nevada Mining Analytical Laboratory, except those marked by an asterisk, which were by the U. S. Geological Survey, Federal Center, Denver, Colorado.

GENESIS

Antimony mineralization in Nevada is usually epithermal in character, but in some areas it appears to occur as aureoles around areas of mesothermal lead-zinc-copper mineralization, and in several localities it occurs with apparently higher temperature scheelite deposits. In at least two of these it appears to have been genetically associated with the scheelite. The ore in the Quick-Tung mine contains stibnite and valentinite intimately associated with scheelite. Minute crystals of stibnite were found in the throat of the hot-springs at Steamboat, and have been found in one area at the Getchell mine. In both of these cases the stibnite appears to have been deposited at low temperatures.

Several of the deposits associated with rhyolite flows appear to be quite simple mineralogically, and genetically associated with the wall rock. In many occurrences the solutions containing the antimony appear to have been genetically associated with nearby dikes. In several of the larger deposits no igneous rocks are directly associated with the antimony mineralization, but strong silicification usually accompanies the antimony mineralization in these deposits.

Wall rock appears to have a strong influence upon localization of the antimony, but as is usual in most deposits, structural control is of most importance.

DESCRIPTION OF ANTIMONY OCCURRENCES BY COUNTY

This section contains descriptions of all known antimony deposits in Nevada, including those deposits known to have produced antimony as a primary ore, and those that produced the metal from either antimonial lead ore or as a smelter by-product. It was not within the scope of this study to include descriptions of all occurrences of the many antimony-bearing minerals, many of which are of no economic importance as antimony ores; only those deposits of particular significance were included.

Detailed maps of the more important occurrences are presented, while only reconnaissance maps are included for others. Conventional symbols used on geologic maps are explained in figure 1. Ownership, location, and production data were obtained by personal inspections of properties and talks with mine owners and operators, and from the files of the U. S. Geological Survey, U. S. Bureau of Mines, and private files of several companies and consultants. An attempt was made to correlate all the available data, to trace every mentioned occurrence, and to record all names used for each individual property, so that they can be easily traced in the future. Included with the descriptions are references to the largest scale topographic map covering all occurrences as of June 1961.

The descriptions of individual occurrences have been grouped by counties, and within the county they have been grouped either by mining district or by geographical location. Their approximate locations are plotted on plate 1.

The technical terminology has been simplified as much as possible in order to make the report usable by the greatest number of people. It should be pointed out again that the term "cervantite" has been dropped because it is synonymous with stibiconite. Production has been given in terms of tons of contained antimony in the ore produced; this provides for easier comparisons of production from the various deposits. Every reasonable effort was made to determine the ownership of the various deposits. These data are given together with the date obtained. Samples were cut and assays made on most of the deposits, but these are not meant to indicate ore grade.

It is requested that any additional information or corrections be sent to the Director of the Nevada Bureau of Mines for use in future publications.

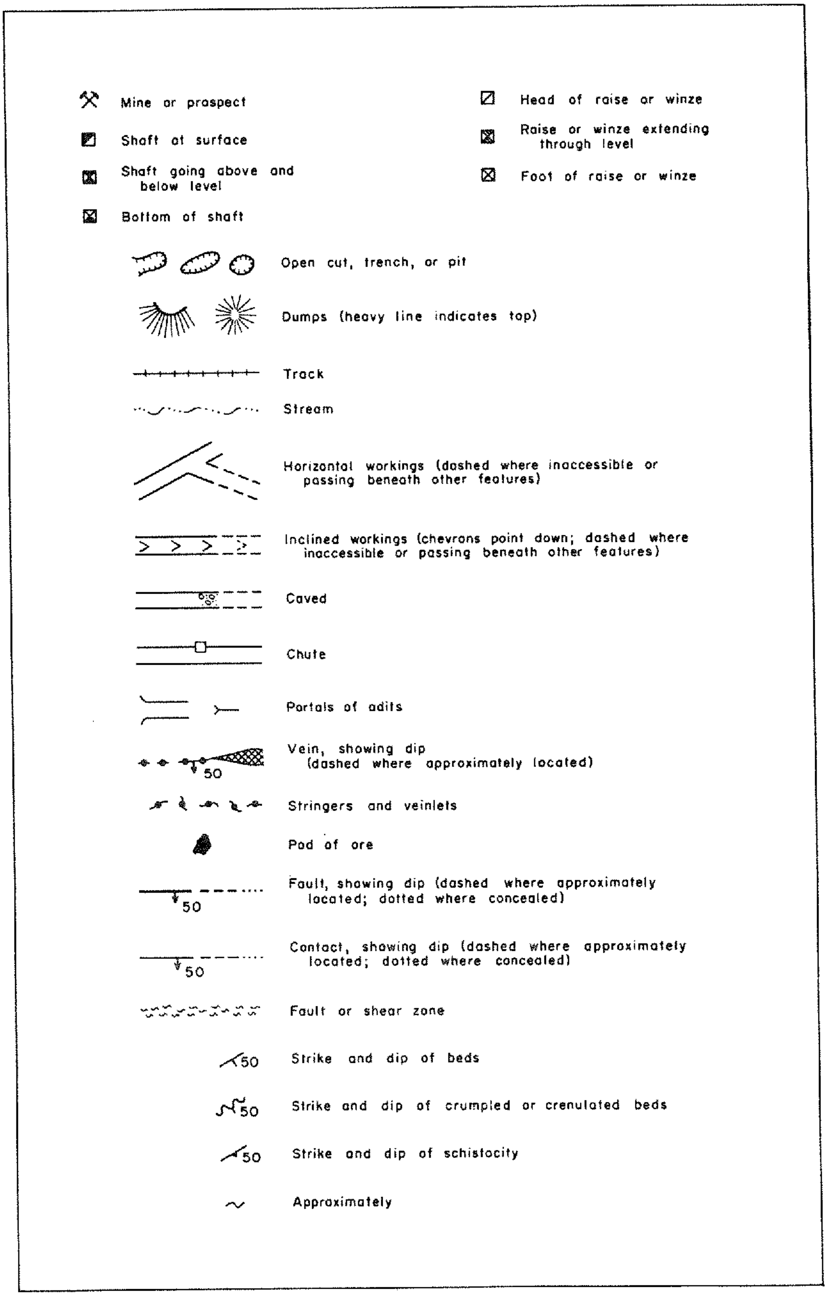

FIGURE 1. Explanation of conventional symbols used in illustrations.

CHURCHILL COUNTY

Bernice Canyon Area

Bernice Canyon is on the west flank of the Clan Alpine Range (fig. 2), about 50 miles north of U. S. Highway 50 and 18 miles northeast of the Dixie Valley School, and includes the Bernice mining district. Gold, silver, and antimony have been produced in this district.

Thin-bedded black slate, gray slate and shale, brown to gray sandstones, some interbedded limestone, and minor quartzite crop out in the district. Schrader (1947, p. 320) correlated these units with the Jurassic(?) Star Peak formation. These sedimentary rocks generally trend northwest and dip to the southwest. Andesite and rhyolite extrusive rocks unconformably overlie the sedimentary rocks. Several basalt and andesite dikes cut the other rocks. Two latitic(?) sills, striking northerly and dipping to the west, crop out in the mine area. The sills are roughly parallel and approximately 300 feet apart. They were mistaken by Mallery (1916, p. 556), Schrader (1947, p. 323), and Vanderburg (1940, p. 17) for limestone beds. Although alteration has obscured the original texture, the sills apparently were porphyritic, with up to 20 percent plagioclase and orthoclase phenocrysts in a fine-grained groundmass of feldspar and quartz having a diabasic texture. The phenocrysts commonly are sericitized, and the groundmass commonly is silicified.

Antimony King mine

Other names	Solomon King, Solomon, Volks, Blue Bird, Van Reed, Turley, J. P. Williams
Location	Sec. 23, T. 22 N., R. 37 E.
Ownership	Howard Turley (1960).
Antimony production	175 tons antimony (metal).
Base map	U. S. 1:250,000 scale topographic map, Millett sheet.

The Antimony King mine is situated along the south side of Bernice Canyon, 2.4 miles from its mouth. The mine was first worked as a unit with the I.H.X. mine, which makes it difficult to determine how much production should be credited to each.

The mine is developed by three adits, several trenches, and stopes (pl. 2). The main vein at the mine strikes N. 10°–25° E. and dips 40°–55° W. A vein seen in the northwest crosscut strikes N. 25° W. and dips 55° W.; whether this is the same vein or a second vein along a cross fault is not clear. The vein roughly

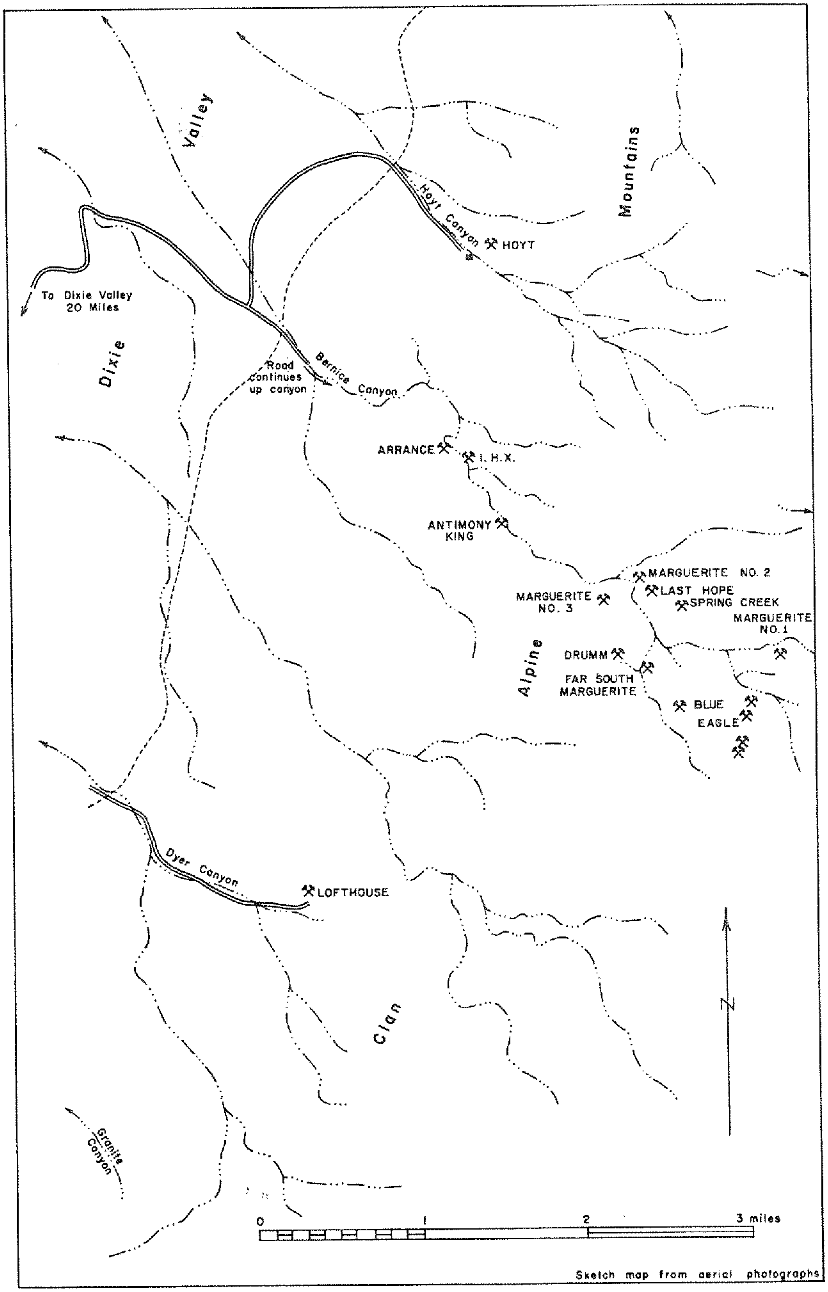

FIGURE 2. Antimony mines and prospects, Bernice Canyon area, Clan Alpine Mountains, Churchill County, Nevada.

parallels a highly fractured and brecciated sill, in some places following the hanging wall and elsewhere following the footwall. Although the latitic(?) sill is commonly concordant with the sandstone and slate, locally it crosscuts them. The sill is porphyritic, with phenocrysts of orthoclase and plagioclase in a groundmass of feldspar and quartz. It has been completely silicified and sericitized.

The vein varies from a few inches up to 48 inches in width, and is composed principally of quartz. Stibnite occurs as pods, blebs, and veinlets in the quartz vein and in the fractured sill. On the lower level the vein opens into a 48-inch mass of quartz containing pods of stibnite up to 2 feet across. Some arsenopyrite, pyrite, and sphalerite are associated with the stibnite. Pyrite is also found as small cubes enclosed in shells of stibnite in the sill.

Assays from the Antimony King mine are as follows:

Location	Description	Sb %	Se %	Au oz.	Ag oz.
Inclined shaft at surface	3-inch vein	12.71	None	None	0.90
Upper adit, at 60 feet	½- to 2-inch veinlets in dike	33.42	None	None	0.76

The stibnite in the vein is partially oxidized to yellow and white antimony oxides. The yellow oxide is especially abundant along joints in the sill where veinlets of stibnite up to three-fourths of an inch thick have been mostly oxidized. The halos of stibnite around the disseminated pyrite cubes commonly are oxidized to brown and black oxides.

Arrance prospect

The Arrance prospect is located in sec. 23, T. 22 N., R. 37 E., on the south side of Bernice Canyon, 1.7 miles from its mouth, and about 40 feet above the canyon floor (fig. 2). The prospect can be located by using the U. S. 1:250,000 scale topographic map, Millett sheet. Production has totaled less than half a ton of antimony metal. The present owner (1957) is Dan Arrance.

The southern sill is exposed in the only working, an open cut (pl. 2). Here the sill is 17 feet thick, strikes N. 5° W., and dips steeply west. Its composition is about the same as that found at the I.H.X. and Antimony King mines. Brown to reddish-brown shale is in contact with the sill on the east; reddish sandstone is seen along the west side of the sill. Stibnite occurs as veinlets up to three-fourths of an inch wide along fractures in the sill, and as small crystals and halos around pyrite grains disseminated through the sill. Most of the stibnite in the fractures is altered to yellow and minor amounts of white antimony oxides.

Blue Eagle group

The workings of the Blue Eagle group are in sec. 25, T. 22 N., R. 37 E. on the northeast slope of a southeast-trending canyon which takes off from Bernice Canyon 4 miles from its mouth. They can be located by using the U. S. 1:250,000 scale topographic map, Millett sheet. In 1956 they were held by E. E. Volks. There are 4 adits, 2 winzes, and 1 open cut, totaling 322 feet.

Shale and sandstone crop out in this area. A fine-grained dike, striking east and dipping 70°–80° S., cuts the sedimentary rocks down the canyon from the mine (pl. 2).

At adit 1, brown, medium-grained sandstone and brown, thin-bedded shale, strike N. 45° W. and dip 80° SW. No antimony minerals were noted at this adit.

Adit 2, directly up the hillside and 35 feet south of adit 1, exposes a 4-inch vein of quartz containing pods of stibnite, striking N. 40° E. and dipping 35° NW.

Adit 3 is 1,000 feet south of adit 2. The country rock is reddish-brown sandstone. A vein, striking N. 20° W. and dipping 30° E., is explored by a vertical winze and an inclined winze. The vein consists of 6 to 18 inches of gouge and 2 to 8 inches of quartz containing small pods, single crystals, and veinlets of stibnite. In the bottom of the inclined winze, a second vein, striking N. 50° W. and dipping 30°–45° NE., intersects the main vein. The second vein consists of 6 to 18 inches of gouge and 4 inches of quartz containing small pods and single crystals of stibnite. A sample of this vein 18 inches wide assayed 0.16 of an ounce of gold and 0.04 of an ounce of silver per ton, 3.21 percent antimony, and no selenium.

Adit 4 crosscuts sandstone and shale for 160 feet before it cuts a quartz-stibnite vein. The sandstone is reddish brown and medium grained, strikes N. 40° W., and varies in dip. It is intercalated with brown fissile shale. The vein, striking N. 50° W. and dipping 45° NE., has 6 to 18 inches of gouge and 4 inches of quartz containing stibnite as small pods and single crystals. A sample of this vein assayed 0.06 of an ounce of gold and 0.26 of an ounce of silver per ton, 21.80 percent antimony, and no selenium.

An open cut in brown sandstone and shale exposes an 18- to 24-inch gouge zone containing traces of quartz and stibnite. The stibnite is slightly altered to yellow and white antimony oxides.

Drumm mine

Other names	Larkin, Marguerite No. 10.
Location	Sec. 25, T. 22 N., R. 37 E.
Antimony production	Over 43 tons of antimony (metal).
Base map	U. S. 1:250,000 scale topographic map, Millett sheet.

The Drumm mine is on the west side of a southeast-trending side canyon, which meets Bernice Canyon 3.8 miles from the mouth of the canyon, 500 feet above the canyon floor. The mine is developed by a 22-foot adit, 40-foot crosscut, and a 95-foot inclined winze (pl. 2).

In 1940, 28 tons of ore averaging 52 percent antimony were produced. During 1941 and 1942, 57 tons of ore containing 48.2 percent antimony were produced.

The country rock is brown shale dipping 80° E. A dense, brown sill crops out below the portal of the adit. It is highly sericitized, but apparently was composed of at least 10 percent feldspar phenocrysts in a groundmass of feldspar and quartz.

A 6-inch quartz vein containing numerous pods of stibnite up to 10 by 24 inches in size is exposed in the adit. One limb of the vein strikes N. 25° E. and dips 15° E.; the other limb dips 35° to the west. The winze was sunk in the westward-dipping limb of the vein. A 6-inch wide sample of the easterly dipping limb assayed a trace of gold and 0.04 ounce of silver per ton, and 16.37 percent antimony. The width of the vein varies greatly in the winze, but at the bottom a brecciated zone up to 48 inches wide has been recemented by quartz containing pods and veinlets of stibnite. In both the adit and crosscut, small pods of stibnite are disseminated through the wall rock. The stibnite has been oxidized slightly to yellow antimony oxides.

Hoyt mine

Other names	De Longchamps, Coplan.
Location	Sec. 14(?), T. 22 N., R. 37 E.
Ownership	Mona Mullen (?).
Antimony production	13 tons of antimony (metal).
Base map	U. S. 1:250,000 scale topographic map, Millett sheet.

The Hoyt mine is located in Hoyt Canyon on the west flank of the Clan Alpine Mountains (fig. 3).

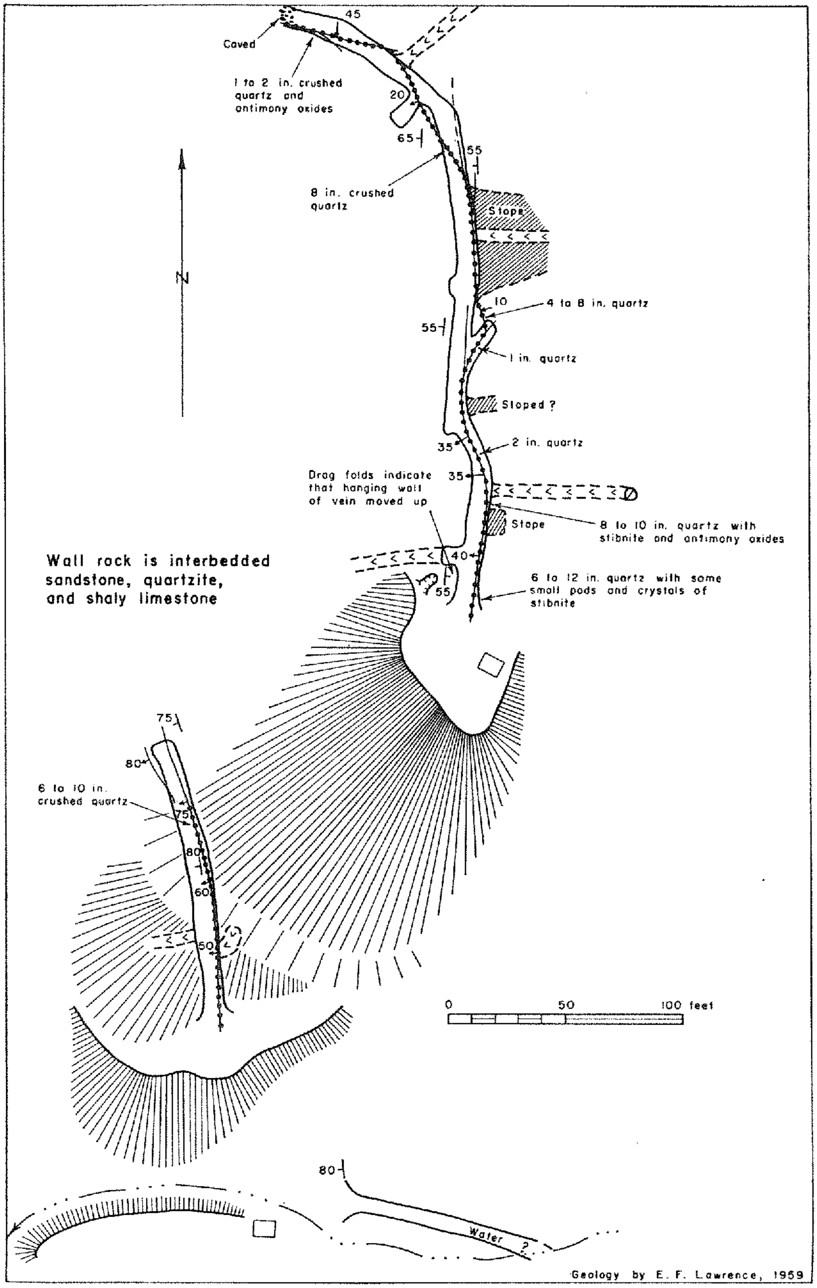

FIGURE 3. Geologic map of the Hoyt mine, Churchill County, Nevada.

About $60,000 worth of silver ore has been mined. The ore was treated in the Bernice mill (Schrader, 1947, p. 322). In 1940–1941, 7 tons of ore averaging 57 percent antimony were produced. In 1949, 16 tons of ore containing 56 percent antimony were mined and shipped to Goldsmith Brothers in Chicago, Illinois. The mine is developed by four adits (fig. 3). One is inaccessible because of water, the other three total 500 feet in length.

At the mine, Jurassic(?) limestone, sandstone, and shale are overlain by rhyolite flows. The main vein strikes N. 5° E. to N. 80° W. and dips 10°–60° SW. It is 4 to 12 inches thick and is composed of quartz and minor calcite. Locally the quartz is crushed and recemented by later quartz. Small pods and single crystals of stibnite and tetrahedrite are scattered through the quartz. Marcasite, pyrite, and arsenopyrite are associated with the antimony minerals. The stibnite is partially altered to earthy or powdery, yellow antimony oxides.

The upper adit on the south side of the creek is 138 feet long, cross-cutting the vein at 20 feet where it is 2 to 12 inches wide and consists of quartz with only minor amounts of stibnite and antimony oxides.

Mallery (1916, p. 556) emphasized that ore shoots occur at the intersection of the vein and a siliceous limestone bed; however, the present study failed to show any such relationship.

I.H.X. mine

Other names	Draken, Soloman, Volks, Blue Bird, Williams.
Location	Sec. 23, T. 22 N., R. 37 E.
Antimony production	25–50 tons antimony (metal).
Base map	U. S. 1: 250,000 scale topographic map, Millett sheet.

The I.H.X. mine is on the north side of Bernice Canyon, 1.9 miles from its mouth, and about 40 feet above its floor.

Several shipments of antimony ore were made in 1915–1917, and in 1940, five tons of ore averaging 43.9 percent antimony were produced. Schrader (1947, p. 324) reports several hundred feet of drifts and stopes extending from a "lower crosscut tunnel," (pl. 2). These workings are completely inaccessible. A shaft, inclined 20° northwest, is open to 120 feet. Also, there are two open cuts.

Shale, sandstone, and interbedded limestone crop out at the mine. An 8- to 12-foot wide, blocky, latitic sill, striking N. 10°

W., has intruded a fracture zone in brown to gray slightly calcareous shale. The hanging wall dips 70°–85° W.; the footwall dips 60°–85° W. At least three sets of joints occur in the sill: one set is essentially horizontal and perpendicular to the sill walls; the other two sets are oblique. This sill is parallel to another of similar texture and composition on the south side of the canyon, approximately 300 feet to the south.

Stibnite occurs as 2- to 4-inch pods and single crystals in a 16-inch gouge zone along the footwall of the sill; as pods up to 8 by 18 inches and as veinlets along the joints; and as halos around pyrite grains disseminated through the sill. Much of the stibnite is altered to earthy to powdery, yellow antimony oxides. Minor white oxides also are present.

Lofthouse mine

Other names	Dyer Canyon prospect, Danielson prospect.
Location	Sec. 26(?), T. 22 N., R. 37 E.
Ownership	Thomas Ormachea(?), of Fallon.
Antimony production	21 tons antimony (metal).
Base map	U. S. 1:250,000 scale topographic map, Millett sheet.

The Lofthouse mine is situated on the west flank of the Clan Alpine Mountains in Dyer Canyon, 1.4 miles from its mouth.

A small amount of antimony ore reportedly was mined during World War I (Schrader, 1947, p. 324). In 1940, two tons of ore averaging 30 percent antimony were produced. In 1948, 40 tons of ore averaging 50 percent antimony were shipped to the Harshaw Chemical Co. in Los Angeles. The mine is developed by two adits each 100 feet long and a number of trenches (fig. 4).

Jurassic(?) slate, limestone, sandstone, and quartzite, generally striking N. 60° W. and dipping 60°–80° SW., crop out at the mine. The main vein strikes N. 45° E. and dips 60°–75° SE. A second vein, striking N. 10° E. and dipping 45° W., intersects the main vein. The veins are 2 to 30 inches wide; the main vein averages 10 inches in width. Both veins are composed principally of quartz with minor calcite. Pods, veinlets, and single crystals of stibnite occur in and with the quartz. One pod was 12 by 16 by 3 inches; individual crystals are up to 2 inches long. Minor amounts of tetrahedrite and rare jamesonite also occur in the veins. The stibnite is later than most of the quartz, and the jamesonite postdates both stibnite and quartz. The stibnite commonly is partially altered to yellow, white, brown, and green

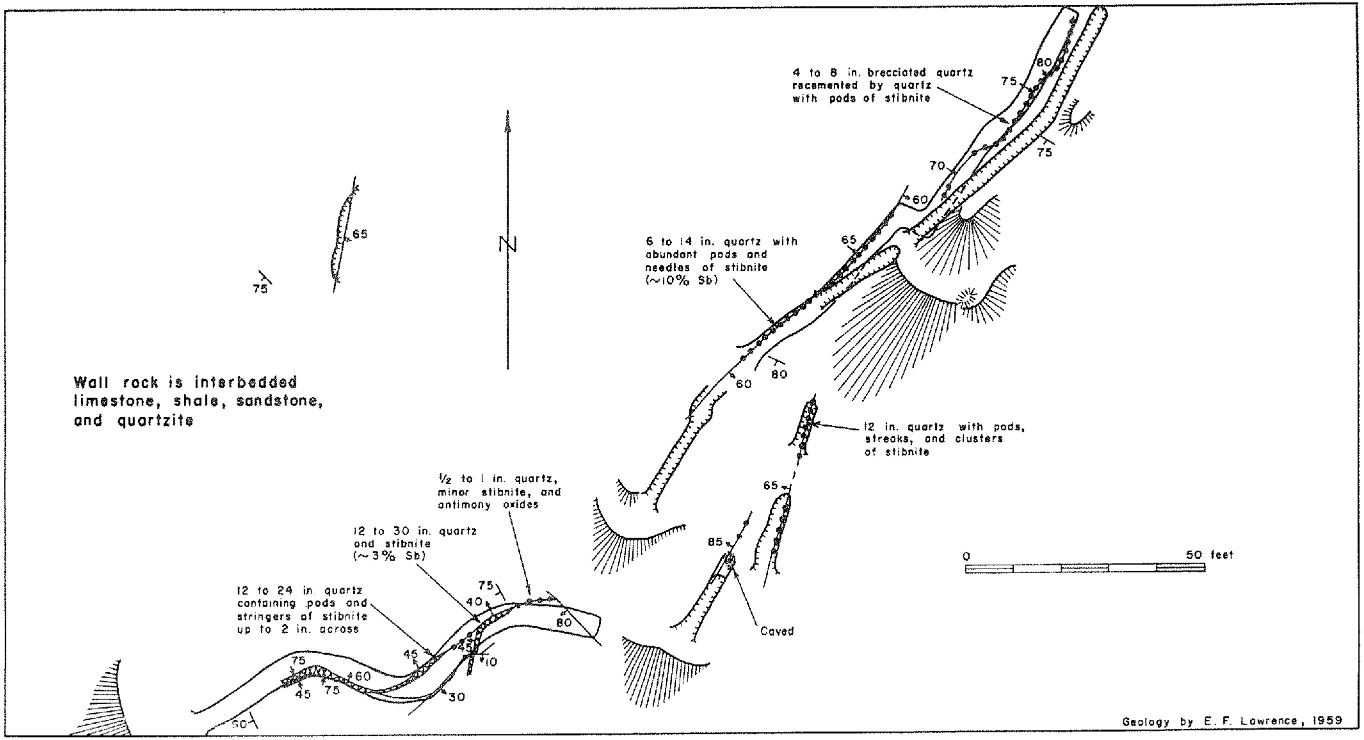

FIGURE 4. Geologic map of the Lofthouse mine, Churchill County, Nevada.

antimony oxides. More rarely the red oxysulfide, kermesite, is seen. The yellow oxide is resinous to earthy; the green and brown oxides are resinous; the white oxide is fibrous. The first stage in the oxidation process is the conversion of the stibnite to the oxysulfide which, in turn, is oxidized to the other oxides.

Marguerite group

The mines of the Marguerite group are found along both sides of Bernice Canyon, (pl. 2) 2.9 to 4.3 miles from its mouth, in secs. 24 and 25, T. 22 N., R. 37 E. This group was held in 1957 by William Sizemone, Dan Arrance, and J. R. Anderson.

Marguerite No. 1 prospect. The Marguerite No. 1 prospect is along the south side of Bernice Canyon, 4.3 miles from the canyon mouth, some 800 feet above its floor.

An open cut exposes a 14- to 18-inch vein, striking N. 5° E. and dipping 30° E. (pl. 2). The vein is composed of 8 to 10 inches of quartz and 6 to 8 inches of gouge. Small pods up to 1 by 2 inches, blebs, and single crystals of stibnite occur in the quartz. The stibnite is almost completely altered to yellow antimony oxides.

The vein, also, is exposed in an 18-foot inclined shaft. Here the vein strikes N. 20° E. and dips 30° SE. It is 10 to 14 inches wide and composed of gouge with only traces of stibnite and yellow antimony oxides.

Marguerite No. 2 prospect. The Marguerite No. 2 prospect is along the north side of Bernice Canyon, 3.3 miles from the mouth. It is developed by two adits, one directly above the other.

The country rock is brown shale and reddish-brown sandstone, striking N. 10° E. and dipping 75° W. Sixty feet from the portal, the lower adit intersects a vein, striking N. 15° W. and dipping 20° SW. This vein was followed for 55 feet by a drift. A second vein, striking N. 15° W. and dipping 45° SW., intersects the other vein. Both veins consist of elongate pods and streaks of stibnite in quartz. A number of veinlets of quartz, calcite, and stibnite extend between the two veins. The whole zone of stringers probably contains 2 percent antimony. The stibnite is partially altered to yellow and white antimony oxides.

In the upper adit, the vein was encountered 70 feet from the portal and followed for 30 feet by drifting, but no ore was found.

Marguerite No. 3 prospect. The Marguerite No. 3 prospect is situated in a ravine on the south side of Bernice Canyon 2.9 miles from the mouth of the canyon and about 800 feet above the canyon floor. The prospect is developed by a 10- by 12-foot open cut.

The open cut is in an 18-foot sill, striking N. 50° W. and dipping 85° SW., in brown shale (pl. 2). Stibnite occurs as ¼- to 1-inch stringers along prominent joints, striking N. 50° W. and dipping 10° N. A sample from these stringers assayed a trace of gold and 0.59 ounce of silver per ton, and 57.57 percent antimony. No selenium was detected. A sample taken from the dump assayed 0.04 ounce per ton of silver, no gold, and 5.9 percent antimony. Stibnite also occurs as tiny blebs and ⅛- to ¼-inch pods disseminated in the sill. The stibnite is partially altered to yellow and white antimony oxides.

Last Hope prospect. The Last Hope (Elvira of Noral) prospect is along the north side of Bernice Canyon 3.3 miles from the mouth of the canyon and just east and below the Marguerite No. 2 prospect.

An adit cuts reddish-brown sandstone (pl. 2). Twenty-one feet from the portal there is a 2- to 3-inch quartz vein striking N. 60° E. and dipping 70° NW. Small pods, veinlets, and single crystals of stibnite occur in the quartz. In the 24-foot vertical winze, the vein widens to 20 inches of quartz containing stibnite. A sample of this vein assayed 0.20 ounce of silver per ton, no gold, and 11.50 percent antimony. One pod, 20 by 48 inches, contains approximately 35 percent antimony. Some small pods are up to 4 inches across. The shale and sandstone along the vein have been highly argillized.

Spring Creek prospect. The Spring Creek prospect is on the north side of Bernice Canyon, 3.8 miles from its mouth, and high on the hillside some 1,500 feet from the canyon bottom and the road. One open cut and a caved adit were found (pl. 2). No antimony mineralization was seen on the surface, but approximately 200 pounds of ore averaging 15 percent antimony were seen on the dump. A sample grabbed from the dump assayed 6.48 percent antimony, 0.08 ounce of gold and 0.28 ounce of silver per ton, and a trace of selenium.

Far South Marguerite prospect. The Far South Marguerite prospect is on the east side of a southeast-trending gulch, which takes off from Bernice Canyon 3.8 miles from its mouth, and only a short distance above its floor. The prospect is developed by a trench and two adits, now caved (pl. 2). The 28-foot trench explores a sill, striking N. 50° W. and dipping 85° NE., in brown shale and reddish-brown sandstone. The sill is completely silicified and sericitized. Stibnite occurs as ¼- to ¾-inch veinlets along joints in the sill, and as small pods, blebs, and halos around pyrite cubes disseminated through the sill. Considerable amounts of yellow antimony oxides are present, especially along joints.

Lake Mining District

The Lake mining district is located in northwestern Churchill County, east of Huxley on the south end of the West Humboldt Range. Small amounts of salines, limestone, lead, silver, and antimony have been produced from the district.

Green prospect

Other names	Hazel group.
Location	SW¼ sec. 9, T. 23 N., R. 29 E.
Ownership	Southern Pacific Railroad.
Production	1 ton antimony (metal).
Base map	USGS Carson Sink 15′ topographic quadrangle.

The Green prospect is situated on the northwest flank of the Mopung Hills 2½ miles southeast of Ocala.

One ton of ore assaying 58 percent antimony and 1.06 percent selenium reportedly was produced in 1941 (H. Green, oral communication, 1958). Development work consists of three short adits, two shallow shafts, and two open cuts (fig. 5).

At the prospect, rubble, consisting of angular blocks of limestone and rhyolite cemented by Lake Lahontan tufa, lies on limestone and rhyolite bedrock. The massive, gray limestone bedrock strikes N. 30° E. and generally dips 35° W. In places the limestone has been highly silicified, apparently along fracture zones. Antimony occurs as stibnite and bindheimite(?) and other antimony oxides in some of the boulders of the rubble. Apparently the boulders containing the antimony minerals were eroded from a nearby vein or veins which have not been found. The stibnite is bladed and fibrous. It has been oxidized to multicolored antimony oxides, and is visible only as cores within pseudomorphs of the oxides.

The boulders average 2 by 3 inches in size but range up to 30 by 60 by 80 inches. Their size and angularity suggest that the rubble has not been moved any appreciable distance. The workings apparently were driven along the rubble-bedrock contact in order to mine the ore in the rubble, as well as to explore for veins in

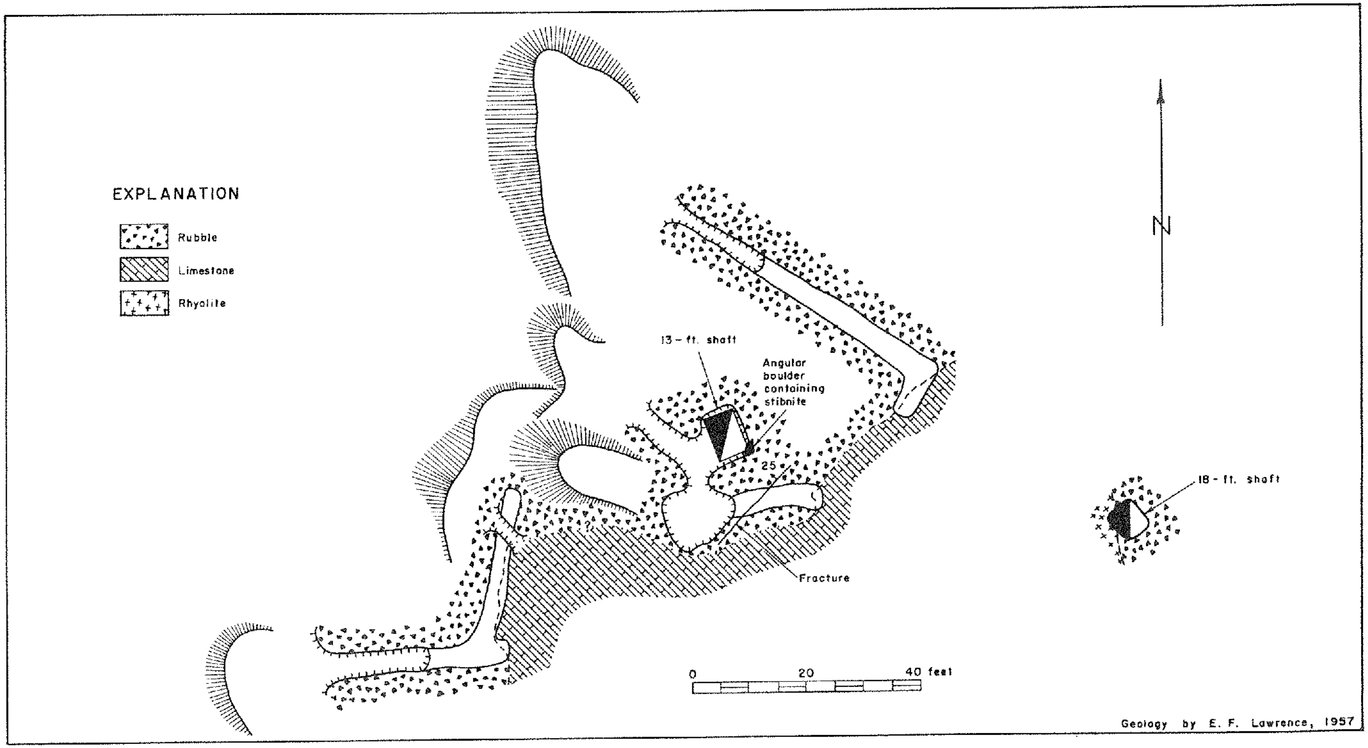

FIGURE 5. Geologic map of the Green prospect, Churchill County, Nevada.

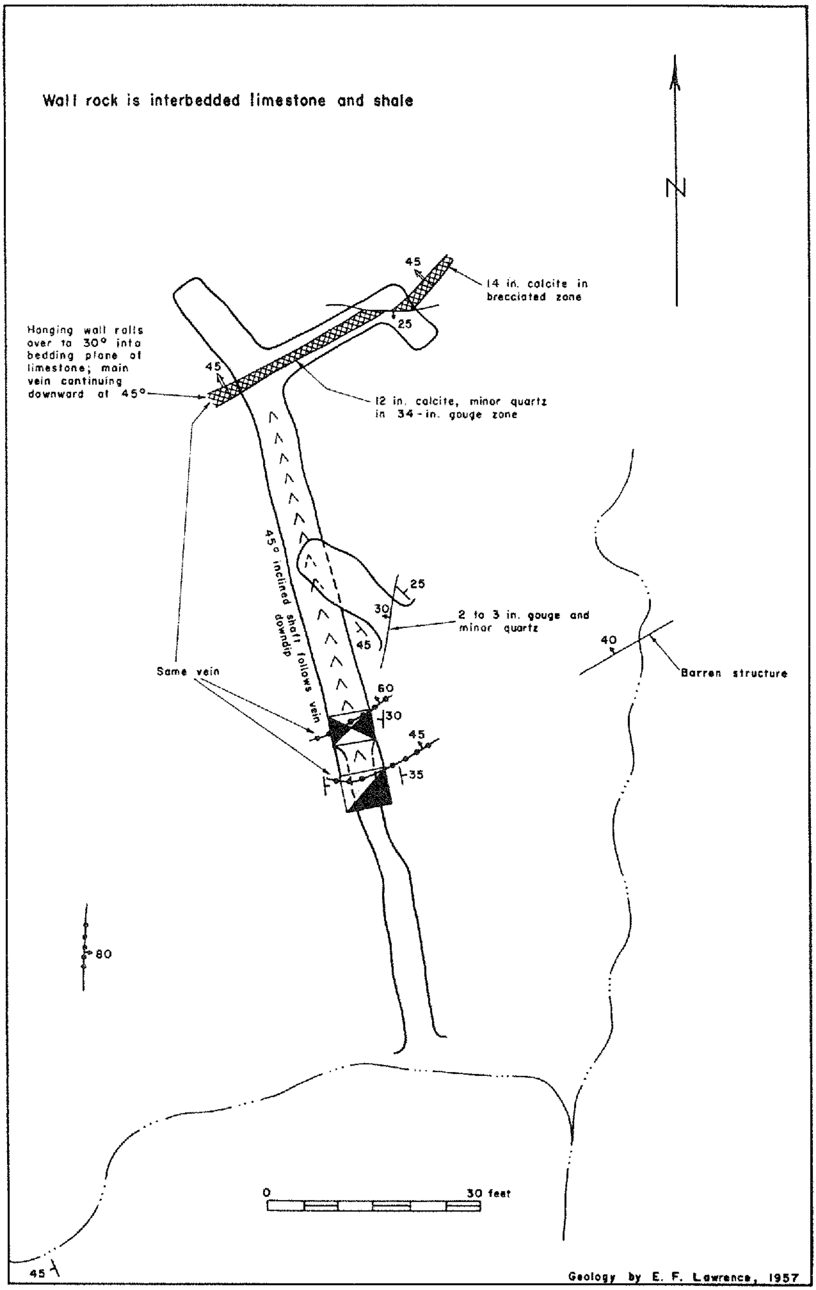

FIGURE 6. Geologic map of the Hazel mine, Churchill County, Nevada.

the bedrock. A sample of stibnite taken from a boulder found in a 13-foot shaft assayed 50.62 percent antimony and 0.29 percent selenium.

Hazel mine

Other names........................Green, James Say.
Location........................SW¼ sec. 9, T. 23 N., R. 29 E.
Ownership........................Southern Pacific Railroad.
Production........................4 tons antimony (metal).
Base map........................USGS Carson Sink 15′ topographic quadrangle.

The Hazel mine is located on the northwest flank of the Mopung Hills, about 2½ miles due south of Ocala and a quarter of a mile south of the Green prospect.

Several carloads of lead-silver-antimony ore were produced in the 1860's, 1870's, and 1880's (Lincoln, 1923, p. 7). Development consists of two adits and an inclined shaft, with a short drift and crosscut at the bottom, totaling 155 feet.

Gray, thin- to massive-bedded, locally highly contorted limestone, and interbedded gray, brown, and red shales crop out at the mine. Tertiary volcanic rocks are exposed nearby. The workings (fig. 6) explore a vein, which strikes N. 60° E. and dips 45° NW. The inclined shaft follows the vein down dip. The vein varies from 30 to 34 inches in width and thickens with depth to the bottom level where it appears to be split into several stringers. It is composed mostly of gouge and 6 to 14 inches of crystalline calcite, with some quartz. Some antimony oxides were observed in the workings, but no stibnite or other primary antimony minerals were seen. Jamesonite, stibnite, and variegated antimony oxides were noted in the dump material. Vein material found on the stock pile assayed 3.81 percent antimony and 0.04 percent selenium.

Other Occurrences in Churchill County

Caddy mine

Other names........................Silver Pride, The Maybe.
Location........................Sec. 21 (?), T. 17 N., R. 35 E.
Production........................None.
Base map........................U. S. 1:250,000 scale topographic map, Reno sheet.

The Caddy mine is located in the Westgate mining district, about 2 miles north of Westgate.

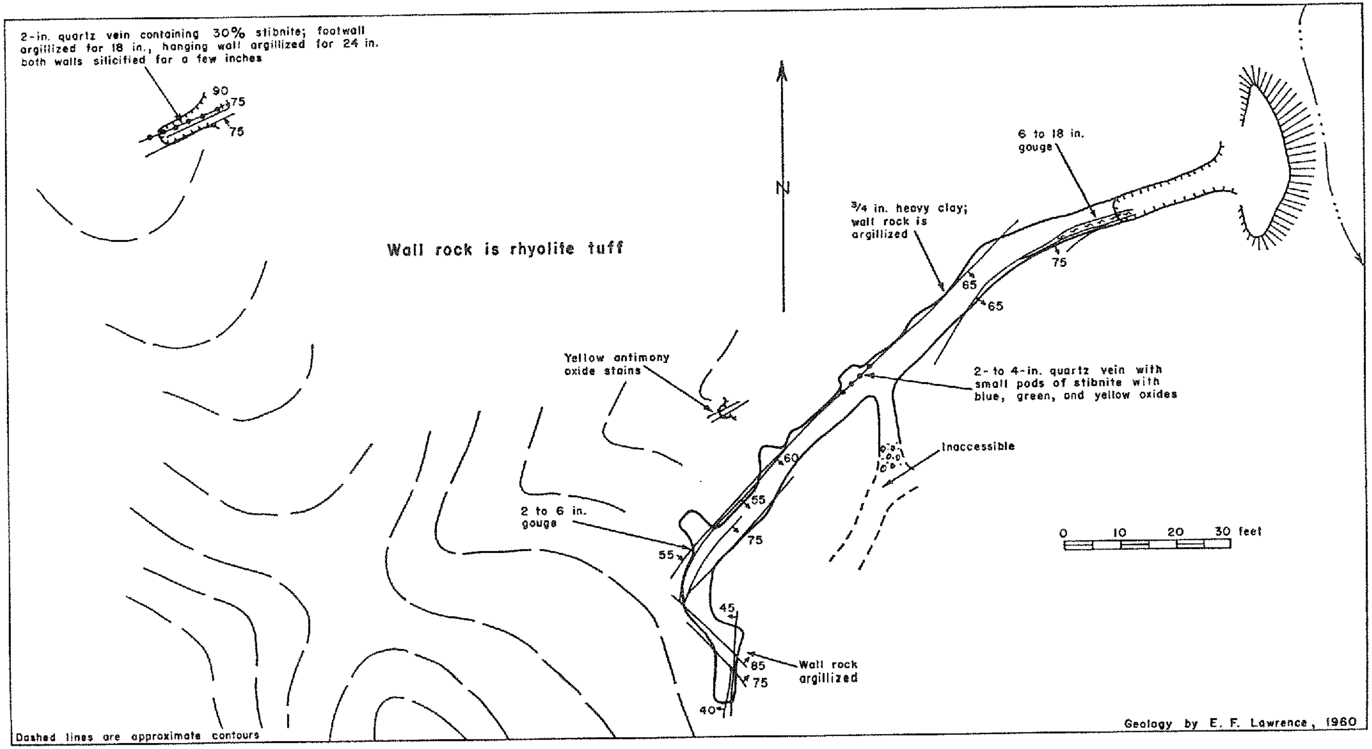

Figure 7. Geologic map of the Caddy mine, Churchill County, Nevada.

The mine is developed by an adit containing approximately 170 feet of workings and two small pits on the slope to the west (fig. 7). Highly fractured and faulted rhyolitic tuffs are exposed at the mine. Triassic limestone, shales, and sandstone crop out approximately half a mile away. Numerous dikes cut the rhyolite near, but not at, the mine.

A shear zone, striking N. 45° E. and dipping 60°–70° SE., cuts the rhyolite. The main adit explores this structure, which varies from 12 to 48 inches in width. One- to two-inch-wide stringers of quartz and stibnite occur in the shear zone. The stibnite is present as single crystals and small pods; white and yellow antimony oxides are common. Both walls are argillized.

One- to two-inch-wide quartz veinlets containing stibnite occur in the upper pit. There the wall rock is argillized up to 18 inches out from the veinlets, and also is slightly silicified a few inches outward from the vein.

Quick-Tung mine

Other names	Shady Run.
Location	Sec. 6(?), T. 22 N., R. 39 E.
Ownership	George Fisk (1960).
Antimony production	None.
Base map	U. S. 1:250,000 scale topographic map, Reno sheet.

The Quick-Tung mine is situated in the Shady Run mining district on the west flank of the Stillwater Range in Fondaway Canyon, 43 miles northeast of Fallon. Gold, silver, lead, iron, tungsten, mercury, and antimony deposits occur in Triassic-Jurassic rocks intruded by quartz porphyry. Tungsten, iron, and cinnabar have been mined.

Schrader (1947, p. 306) reported antimonial silver ore in the mines of Big Elk Canyon just south of Shady Run. In 1960, the Quick-Tung mine was being operated as a tungsten mine, and the ore was being shipped to the Nevada Scheelite Corp.

The mine is developed by several short adits and shallow shafts. At the upper working a 40-foot shaft has been sunk along a contact between limestone and shale. The brown to black shale is thin-bedded. Both the shale and the limestone strike east-west and dip steeply to the north. The limestone occurs in a fault block, has been recrystallized, and is cut by numerous irregular veinlets of quartz up to 24 inches wide.

Scheelite occurs in association with quartz in high-grade pods up to 3 inches in width adjacent to the contact. Stibnite and valentinite(?) are closely associated with the scheelite in the shaft. Pyrite is common in the scheelite area. In the hillside above the shaft, stibnite occurs as blebs, small pods, and scattered crystals in irregular masses and veinlets of quartz. Similar occurrences of stibnite are scattered throughout the limestone outcrop. Some lenses are up to 6 inches wide and 48 inches long. No scheelite was observed in these surface occurrences.

The stibnite has been partially altered to yellow and white oxides. The fibrous to resinous white oxide commonly forms pseudomorphs after stibnite. Cinnabar occurs one-fourth of a mile to the west.

CLARK COUNTY

Goodsprings (Yellow Pine) Mining District

The Goodsprings district is in the western part of Clark County on the southern end of the Spring Mountains approximately 37 miles southwest of Las Vegas. Since its discovery in 1855, a total of $10,425,233 in zinc, lead, copper, gold, silver, molybdenum, vanadium, cobalt, and platinum values have been produced (Couch and Carpenter, 1943, p. 30).

The Spring Mountains consist mainly of sediments from Upper Cambrian to Recent in age. The sediments have been intruded by granite porphyry and numerous small lamprophyre dikes. The principal ore minerals are smithsonite, cerussite, galena, calamine, hydrozincite, anglesite, pyromorphite, cuprite, chrysocolla, malachite, and chalcocite. Cinnabar has been reported a few miles to the north.

Antimony prospect

The Antimony prospect is along the eastern crest of Table Mountain in sec. 3, T. 25 S., R. 58 E., approximately 3 miles southwest of Goodsprings, and half a mile south of the Lookout mine (see USGS Goodsprings special topographic quadrangle). Development consists of three short adits and an open cut.

At the prospect, gray limestone of the Cambrian Bird Spring Formation is in contact with Tertiary andesite and rhyolite (Hewett, 1931, pl. 1). An adit cuts two faults, both striking N. 65° W., one dipping 30° N. and the other 65° N. The limestone between these two faults has been silicified and contains a small amount of stibnite and white antimony oxide as replacements. The open cut and the two adits, which open into it, cut a fault zone 30 feet wide striking N. 10° W. and dipping 25° E. The zone is silicified and contains scattered small pods and large single crystals of stibnite replacing limestone. The stibnite commonly is partially oxidized to white antimony oxides. A sample from the vein 8 inches wide assayed 1.72 ounces of silver per ton and 0.6 percent antimony. The assay revealed no gold in the vein.

Lavina prospect

Stibiconite has been reported as radiating clusters replacing stibnite in a quartz vein at a prospect pit near the center of the southern border of sec. 21, T. 24 S., R. 58 E. (see USGS Goodsprings special topographic quadrangle). This prospect (Hewett, 1931, p. 83, 107) could not be located during the present study.

Yellow Pine mine

The Yellow Pine mine is in sec. 20, T. 24 S., R. 58 E. (see USGS Goodsprings special topographic quadrangle).

Stibnite occurs as radiating crystals in chert nodules in limestone at the contact with a porphyry dike. The stibnite commonly is altered to white antimony oxide (Hewett, 1931, p. 129). This mine was not examined during the present study.

Other Occurrences in Clark County

New Deal mine

The New Deal (Polyanna) mine is 18 miles southeast of Searchlight and 2 miles northeast of Newberry Peak, in sec. 21 (?), T. 30 S., R. 65 E. (Aune, unpublished data, U. S. Bureau of Mines). The mine was last worked in 1933 for silver, lead, and antimony. Antimony occurs as tetrahedrite and antimony oxides in small scattered pods.

Yarmouth mine

The Yarmouth mine is just north of Newberry Mountain in secs. 21 and 28, T. 30 S., R. 65 E., approximately 18 miles southeast of Searchlight, near the New Deal mine described above. Although Aune (unpublished data, U. S. Bureau of Mines) reported the occurrence of antimony minerals, none were found during the present investigation. Silver-lead-zinc ore has been shipped from this mine.

DOUGLAS COUNTY

The mines and prospects described lie at the south end of the Pine Nut Mountains between Gardnerville and Wellington. Antimony occurs in three areas: along the western flank above Double Spring Flat, in Red Canyon near Oreana Peak, and just south of Wellington. A large stock of quartz monzonite has intruded a sequence of Triassic(?) sediments which consist of limestone, shales, and argillites (Hill, 1915, p. 56). Numerous narrow dikes cut the igneous and sedimentary rocks. Contact metamorphism is common along both the stock and the dikes.

Four types of ore deposits have been found in the area: quartz veins in the quartz monzonite, contact metamorphic deposits, replacement bodies, and deposits in the Tertiary volcanics. The ore minerals are chalcopyrite, argentite, stephanite, galena, pyrite, pyrrhotite, stibnite, sphalerite, and native silver. The total production up to 1940 was $138,365, principally in gold, silver, lead, and copper.

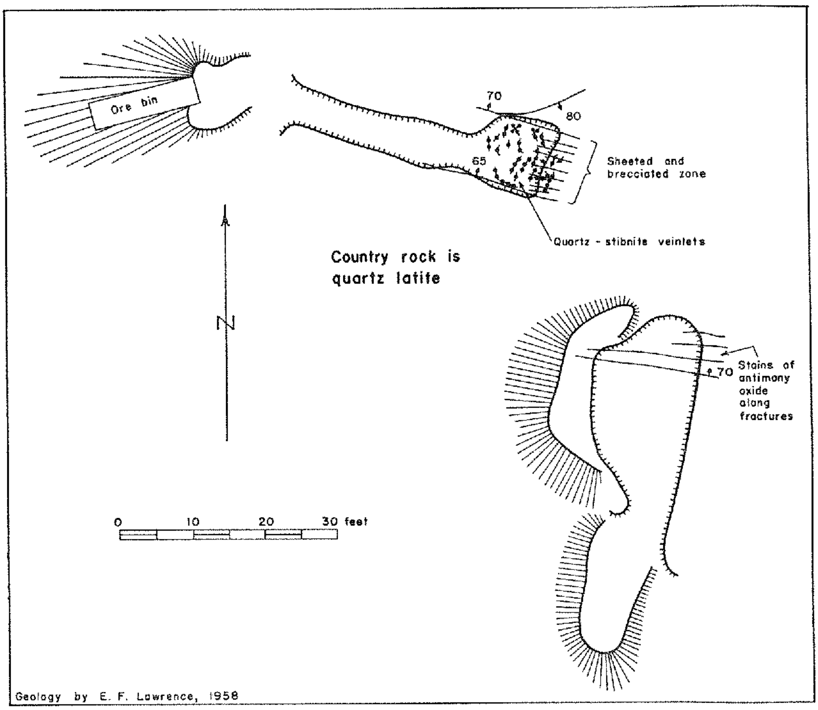

FIGURE 8. Geologic map of the Danite mine, Douglas County, Nevada.

Danite mine

Other names	Silver Queen, Nevada Queen, Schultz Antimony, Old Mammoth lode.
Location	Sec. 10, T. 11 N., R. 21 E.
Ownership	W. C. Clark (1958).
Production	4 tons antimony (metal).
Base map	USGS Mt. Siegel 15′ topographic quadrangle.

The Danite mine is in the Eagle mining district on the west flank of the Pine Nut Mountains, 11 miles south of Gardnerville.

The mine is developed by two adits and by drifts totaling 1,200 feet (Lincoln, 1923, p. 34) which are now caved. In 1957 and 1958, the Metallurgical Development Corp. under lease mined some antimony ore from several open cuts, and milled it at their flotation plant.

At the Danite mine (fig. 8) a porphyritic quartz latite dike, striking N. 65° W. and dipping 65° N., has intruded Tertiary hornblende andesite. Hill (1915, p. 52) gave a brief description of the geology of this area. The dike is sheeted and irregularly brecciated. Numerous quartz veinlets fill the fractures. The dike and country rock have been almost completely silicified. Locally, the dike is argillized where not silicified. The plagioclase phenocrysts have been partially sericitized. Small pods, clusters, streaks, and single crystals of stibnite occur in the quartz veinlets throughout the dike. The quartz is vuggy; some vugs are lined with quartz crystals and needles of stibnite. The stibnite is partially altered to yellow and white antimony oxides. To the northwest, along the same dike, silver occurs as argentite and stephanite in the Veta Grande mine (Overton, 1947, p. 27).

Fullstone prospect

Other names	Bromide mine.
Location	Sec. 24, T. 10 N., R. 23 E.
Ownership	Frank and Arthur Fullstone.
Production	Unknown.
Base map	USGS Desert Creek Peak 15′ topographic quadrangle.

The Fullstone prospect is on the north end of the Wellington Hills, 6 miles south of Wellington, at a contact between granodiorite and north-trending Triassic limestone. Hill (1915, p. 52) gives a description of the geology of the area. Tuffaceous sediments crop out in the hills to the west. A rhyolite dike, less than a foot wide, parallels the contact, striking N. 10° E. and dipping 55° W. Exploration work consists of two pits. Two veins, striking N. 10° W., intersect the dike. The veins are 8 to 10 inches wide, and contain abundant quartz, pyrite, minor calcite, and some chalcedony and opal. Pods and single crystals of stibnite up to 2 inches long occur in the quartz. The stibnite is partially oxidized to yellow and white antimony oxides. The white oxide usually is fibrous but the yellow oxide commonly is powdery. Both yellow and white oxides occur as pods replacing small pods of stibnite.

The mineralization is weak, but extends for several hundred feet along the ridge. Only minor wall-rock alteration is present. Analyses of two samples taken from this prospect are shown below:

No.	Location	Description	Sb %	Au oz.	Ag oz.	Se %	Pb %
182	Prospect pit	12-in. quartz	0.39	None	None	....	None
183	Prospect pit	8-in. quartz	1.48	None	0.02	None	....

Iron Pit prospect

Other names .... Lucky Bill, Mary and Dolly.
Location .... Sec. 2, T. 11 N., R. 22 E.
Ownership .... Charles W. Ouilette (1960).
Antimony production ..... None.
Base map .... USGS Wellington 15′ topographic quadrangle.

The Iron Pot prospect is in the Red Canyon district 1½ miles southeast of Oreana Peak on a spur on the east side of the north fork of Red Canyon. The only work done appears to have been the excavation of several shallow tunnels and cuts, now caved.

A silicified zone, striking east-west, cuts calcareous argillite. According to Hill (1915, p. 62), "Small, very pockety deposits of argentiferous galena, quartz, and stibnite, together with minor quantities of pyrite and chalcopyrite, occur at various places along the fracture zones." Material from the dump contains small blebs and single crystals of stibnite associated with quartz, galena, arsenopyrite, pyrite, and jamesonite. Galena is the most common sulfide present and occurs in pods up to 3 inches across. Commonly the jamesonite and stibnite are partially altered to white, yellow, and pearl-gray antimony oxides. The gray and white oxides occur as pseudomorphs after stibnite and jamesonite. The yellow oxide forms powdery to earthy coatings and masses.

Winters mine

The Winters mine is in sec. 26, T. 12 N., R. 22 E., in the Red Canyon district 1½ miles southeast of Mt. Siegel on a spur half a mile north of Oreana Peak (see USGS Wellington 15′ topographic quadrangle). Hill (1915, p. 62) reported that stibnite is associated with galena, pyrite, and chalcopyrite in a 6- to 48-inch quartz veinlet. This mine was not visited, but apparently is similar to the Iron Pot prospect.

ELKO COUNTY

Charleston Mining District

The Charleston mining district is along 76 Creek on the southern flank of Copper Mountain, 20 miles south of Jarbidge. Gold, silver, copper, and antimony have been produced.

Paleozoic sediments are in fault contact with Cenozoic volcanic rocks. The sedimentary rocks have been intruded by a stock of granodiorite and numerous dikes. A skarn zone occurs along the contact of the stock and sedimentary rocks.

Black Warrior mine

The Black Warrior mine is on the divide between 76 and Badger Creeks. P. R. Prunty is the owner. The vein here is a continuation of that in the Graham mine (see below). It is developed by a 120-foot vertical shaft and an adit (now caved) connecting with the shaft. There is a prominent gossan. Copper and gold values reportedly increase with depth (R. Prunty, oral communication, 1956).

Bounty claim

Antimony reportedly occurs in a small adit approximately 2,000 feet north of the road in a clump of trees due east of the Prunty mine (R. Prunty, oral communication, 1956). This adit was caved. A small amount of yellow antimony oxide is present in the dump material.

Graham mine

Other names	Prunty.
Location	Sec. 13, T. 44 N., R. 57 E.
Ownership	Robert Prunty (1958).
Production	None.
Base map	U. S. 1:250,000 scale topographic map, Wells sheet.

The Graham mine is in a gulch on the west side of 76 Creek on the southwest flank of Copper Mountain, 0.4 mile south of the Prunty antimony mine described below. Mine openings consist of seven adits and a shaft; all are caved except one adit.

Vein material from the dump contains stibnite, arsenopyrite, pyrite, tetrahedrite, and chalcopyrite in quartz and calcite. Stibnite is scattered sparsely through the vein material as single crystals, apparently deposited later than the arsenopyrite. A grab sample of ore stockpiled on the dump assayed 0.26 percent antimony, 0.018 percent selenium, 0.9 percent copper, 0.80 ounce of gold, and 2.08 ounces of silver per ton.

Prunty antimony mine

Other names............Rattler, Prunty No. 7 claim.
Location............Sec. 13, T. 44 N., R. 57 E.
Ownership............Robert Prunty (1958).
Production............16 tons antimony (metal).
Base map............U. S. 1:250,000 scale topographic map, Wells sheet.

The Prunty mine is at stream level on both sides of 76 Creek, 3.2 miles above the Prunty Ranch on the Deeth-Charleston-Jarbidge road.

In 1907, 30 or 40 tons of antimony ore were mined and shipped to France for a net value of $60. The property is developed by two shallow shafts and two adits, all of which are inaccessible.

The mine is along a fault contact between Tertiary rhyolite and Paleozoic shales. Blebs, small pods, bladed aggregates up to 6 inches across, and single crystals of stibnite up to 1 inch long are scattered randomly through quartz. Pyrite, arsenopyrite, and sphalerite are associated with the stibnite. Arsenopyrite is most common, occurring as small pods, blebs, and single crystals; it appears to have been deposited later than the stibnite. Pyrite is the least abundant. Stibnite is also present as minute grains in a gouge zone which strikes N. 20° W. Part of the stibnite has been replaced by powdery to vitreous, yellow antimony oxide. The following table shows analyses of four samples taken from the Prunty antimony mine.

No.	Description	Sb %	Au oz.	Ag oz.
12	Grab sample, old dump, No. 7 claim	12.5	0.42	1.80
13	Grab sample, stockpile, south shaft, No. 7 claim	11.3	None	4.78
48	Grab sample, stockpile, No. 7 claim	29.68	0.24	0.47
49	12-inch vein, No. 7 claim	0.70	None	0.82

Rescue mine

Other names............Kaff-rock.
Location............Sec. 14, T. 44 N., R. 57 E.
Ownership............R. S. O'Brock and Ralph Kaffka (1957).
Base map............USGS Mt. Velma 15′ topographic quadrangle.

The Rescue mine (pl. 3) is on the southwest flank of the Copper Mountains, half a mile west of the Prunty mine. Mine workings consist of a 60-foot, 40° inclined shaft, a (caved) vertical shaft, a number of open cuts, and three adits, totaling 500(?) feet.

Granodiorite has intruded undifferentiated Paleozoic sedimentary rocks in the vicinity of the mine. Immediately north of the mine, limestone, shale, and quartzite crop out. Several narrow rhyolitic to andesitic dikes cut the other rocks. A narrow shear zone marks the granodiorite-sedimentary contact.

Stibnite was observed only in the stockpile at the southwesternmost pit and adit. It occurs as small, granular pods, bladed aggregates, and single crystals, associated with sphalerite, tetrahedrite, pyrite, and arsenopyrite. An assay of this material gave 18.44 percent antimony, 15.7 percent zinc, and no lead; and 0.12 ounce of gold and 2.88 ounces of silver per ton. In the adit directly below, a vein contains quartz but no antimony minerals. In the northwesternmost adit a 3- to 5-inch vein, striking N. 60° E. and dipping 65° SE., consists of 1 to 3 inches of quartz and traces of sphalerite but no antimony minerals. A vein, striking N. 10° E. and dipping 40° E., is exposed in the inclined shaft, the northeasternmost working; it consists of 2 to 12 inches of quartz with a few blebs and single crystals of stibnite and yellow antimony oxide. A stockpile on the dump at the inclined shaft contains arsenopyrite, pyrite, chalcopyrite, sphalerite, tetrahedrite, and minor stibnite as blebs, small pods, and single crystals; a grab sample of this material assayed 0.91 percent antimony and 4.38 ounces of silver per ton.

Independence Mountains

A number of antimony mines and prospects are located in the Independence Mountains, and extend for 27 miles north from Taylor's Canyon. The northern end of this area has been described by Decker (1962).

Sedimentary rocks of both the Eastern and Western assemblages crop out in the range. A thrust fault, which probably is a continuation of the Roberts Mountains thrust fault, occurs along the crest of the range in the southeast corner of the Bull Run quadrangle (Decker, 1962). The range is bounded on the east and west by north-trending high-angle faults.

Birds Eye prospect

Other names .... Lost, Bilboa, Kilburn, Snow Creek, Belaustegus Ranch mine.
Location .... Secs. 2 and 11, T. 40 N., R. 53 E.
Ownership .... Vincente and Thomas Bilboa (1957).
Production .... None.
Base map .... U. S. 1:250,000 scale topographic map, Wells sheet.

The Birds Eye prospect is found at the head of Jerrett Creek on the crest of the Independence Mountains, 5 miles east of the Doheny (Alberts) Ranch and 4 miles north of Taylor. The prospect is developed by several pits and trenches.

Bluish-gray, thin-bedded to massive limestone, generally striking N. 30° W. and dipping 25°–35° NE., crops out at the mine. Several brecciated, silicified zones containing quartz veins cut the limestone. Barite is common both as fissure fillings with the quartz, and as crystals perched on antimony minerals in vugs.

There are two areas of mineralization about 600 feet apart. Three veins occur in the southwestern area. The main vein is 4 to 24 inches thick, strikes N. 45° E., and dips 55°–75° NW. A second vein 120 feet to the southeast is 2 to 6 inches wide, strikes N. 60° E., and dips 45°–75° SE. A third vein, 100 feet north of the main vein, is 14 inches wide, strikes N. 45° E. and dips 75° SE. Stibnite occurs in these veins as blebs, small pods, rosettes, single bladed crystals in vugs, and as disseminations in the silicified limestone.

In the northeastern area, the main vein is 35 inches wide, strikes N. 30° E., and dips 65°–85° NW. Blebs, small pods, and single blades of stibnite occur in the vein. A 45-inch-wide fractured zone strikes N. 35° W. and dips 80° W. Within this fractured zone, prominent jointing, perpendicular to the walls, dips 25° N. Discontinuous pods of stibnite, up to 4 inches thick and 12 inches long, occur along these joints. This stibnite is bladed, some blades being 7 inches long. Analyses of four ore samples from this prospect are shown below.

No.	Description	Sb %	Au oz.	Ag oz.	Pb %
33	14-in. vein, southwestern area	0.55	Trace	0.48	None
34	26-in. vein, southwestern area	0.55	None	0.54	....
35	26-in. vein, southwestern area	10.04	None	0.52	....
36	12-in. vein, northeastern area	0.73	Trace	0.42	....

Pseudomorphs of white antimony oxide after stibnite are common as small pods of bladed material and as needles in vugs.

Some oxidized stibnite needles are enclosed by barite crystals. Some yellow antimony oxide replaces the white oxide and occurs as powdery to earthy masses in fractures.

Burns Basin mine

Other names	Lonesome Kid, Williams, Byrne Basin, Parker, Chaffie, Griffith, Andrae.
Location	Sec. 22, T. 40 N., R. 53 E.
Ownership	Dan Williams and Dan Andrae (1957).
Production	20 tons antimony (metal).
Base map	USGS Tuscarora 15′ topographic quadrangle.

The Burns Basin mine is in Burns Basin near the head of Burns Creek on the west flank of the Independence Mountains (fig. 9).

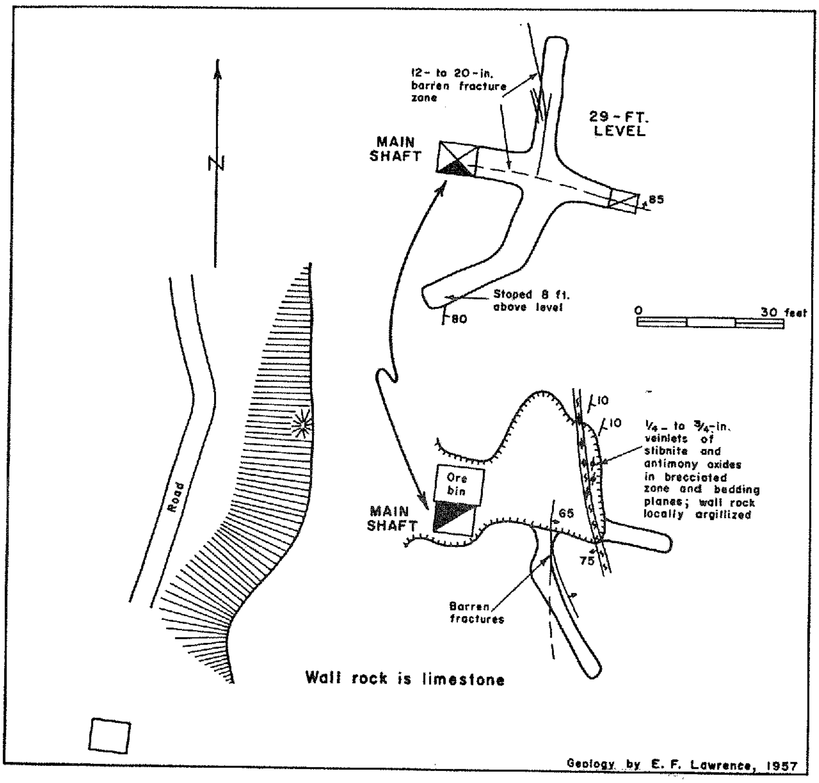

FIGURE 9. Geologic map of the Burns Basin mine, Elko County, Nevada.

One carload of antimony ore reportedly was shipped in 1918.

Mine openings consist of a 29-foot vertical shaft with 80 feet of underground workings, including two raises, two adits totaling 40 feet, and an open pit. Several small pits were dug in similar outcrops to the south without developing any ore bodies.

The mine is in an area of uplifted and folded Paleozoic sedimentary rocks. These rocks are principally thin-bedded limestone and quartzite which generally strike N. 20° E. and dip 10° E. A 12- to 18-inch-wide fracture zone, striking N. 10° W. and dipping 75° W. cuts across the pit 17 feet east of the shaft, and also is exposed in the adit 10 feet from the shaft. Most of the mineralization is in the footwall of this fracture zone within 10 feet of it. The entire zone has been silicified and some of the fractures have been filled by calcite and quartz.

Stibnite occurs as blebs, pods, veinlets, bladed single crystals, and needles in vugs. Veinlets up to one-fourth of an inch wide cut the limestone. Euhedral crystals of barite occur along fractures associated with stibnite. The stibnite commonly is altered to yellow and white antimony oxides. Red oxysulfide occurs along cleavages and fractures. The resinous to vitreous white oxide is common as pseudomorphs after stibnite needles in vugs and after bladed stibnite. The yellow oxide replaces the white oxide and stibnite. Antimony, gold, and silver values of five ore samples are shown below.

No.	Description	Sb %	Au oz.	Ag oz.
37	Grab sample, 15-ton stockpile	16.94	None	0.48
1	36-inch vein, top of raise	Trace	....	....
2	72-inch vein, north wall open pit	3.6	....	....
3	72-inch vein, south wall open pit	5.1	....	....
4	Grab sample, dump	5.0	....	....

Eagle prospect

Other names........Griffith.
Location........Sec. 6, T. 39 N., R. 53 E.
Production........None.
Base map........USGS Tuscarora 15′ topographic quadrangle.

The Eagle prospect is at the head of Thomas Jose Creek on the west flank of the Independence Range, 10 miles east of Tuscarora. Development consists of two open cuts.

The country rock is gray limestone and fine-grained sandstone, which generally strikes N. 10° E. and dips 10°–30° E. The limestone has been brecciated, cemented by quartz, and silicified. Two veins cut the limestone; one strikes N. 10° W. and dips 45°–65°

W., the other strikes N. 10° E. and dips 65° W. Both veins average 2 inches in width, but vary from 1 to 24 inches.

The veins are principally quartz with blebs, small pods, (up to 8 inches across), bladed aggregates, and disseminated single crystals of stibnite. Barite with quartz occurs as massive vein-filling and as crystals up to three-fourths of an inch long perched on stibnite. Some of the stibnite is intergrown with barite. The stibnite has been partially altered to yellow and white antimony oxides. The powdery to earthy, yellow oxide occurs as pseudomorphs after stibnite and as thin coatings on quartz and silicified limestone. The fibrous, white oxide forms pseudomorphs after stibnite.

Analyses of three ore samples taken from this prospect are shown.

No.	Description	Sb %	Au oz.	Ag oz.
215	2-inch vein	9.58	0.06	0.14
215A	Grab sample, stockpile of cobbed ore	60.7	......	......
215B	Grab sample, stockpile of cobbed ore	42.1	......	......

Hyer prospect

A prospect containing antimony was reported (Thomas Bilbao, oral communication, 1958) in sec. 17, T. 42 N., R. 53 E., on Chicken Creek, a short distance above Jack Creek in the Independence Mountains (see USGS Bull Run 15′ topographic quadrangle). A field examination failed to reveal any antimony minerals.

Lost and Found mine

Other names..........Josie Savel, Williams, Lost.
Location..........Secs. 9, 10, 15, and 16, T. 40 N., R. 53 E.
Ownership..........Dan B. Williams and Dan Andrae (1957).
Production..........None.
Base map..........U. S. 1:250,000 scale topographic map, Wells sheet.

The Lost and Found mine (fig. 10) is on the west flank of the Independence Mountains 3.5 miles north of the Burns Basin mine. The mine is in a clump of aspens on the northeast face of the ridge. It is developed by an adit, now caved, connecting with an open cut. A second open cut has been made near the crest of the hill.

The country rock is blue-gray, thin-bedded limestone, silicified in the vicinity of the workings. A fractured zone, strikes N. 70°

E. and dips 70° N. in the main workings, and strikes N. 50° E. and dips 55° SE. at the upper open cut. The fractured zone varies in width from 24 to 30 inches in the main workings, to 6 inches at the upper open cut.

Stibnite occurs as single crystals and pods up to 3 inches across in the fractured zone, and as small single crystals in vugs. At a few spots, calcite and quartz occur with the stibnite. Stibnite replaces limestone and commonly is partially altered to yellow and white antimony oxide.

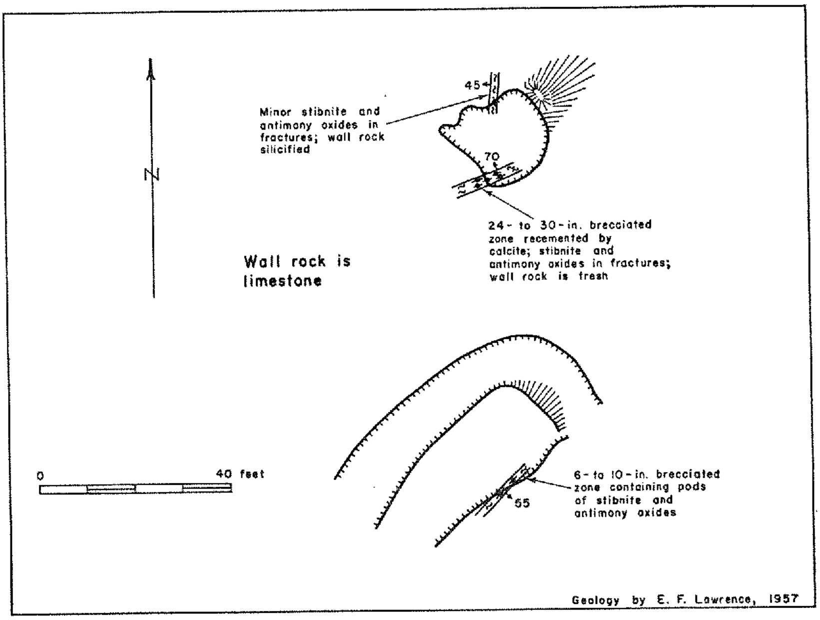

FIGURE 10. Geologic map of the Lost and Found mine, Elko County, Nevada.

Sage Hen prospect

Location .... Sec. 14, T. 42 N., R. 53 E.

Production .... None.

Base map .... USGS Wild Horse 15′ topographic quadrangle.

The Sage Hen prospect is on the east flank of the Independence Mountains, one-fourth of a mile north of Jacks Peak and 200 feet below the crest of the range. The prospect is developed by two pits.

The Cambrian Prospect Mountain Quartzite crops out at the prospect. A thrust fault, dipping gently to the west, has brought shale, limestone, and metavolcanics over the quartzite which locally is brecciated and recemented by quartz.

Veinlets of quartz contain pods, blebs, and single crystals of stibnite, and interstitial barite. The barite occurs as euhedral crystals up to 2 inches long, and as pods enclosing cores of stibnite. Some barite crystals are perched on stibnite. Stubby quartz crystals line vugs. In one specimen quartz coats stibnite and barite. The stibnite is partially altered to powdery to vitreous yellow and fibrous white antimony oxides.

Snyder prospect

Antimony has been reported (Thomas Bilbao, oral communication, 1958) in sec. 19, T. 42 N., R. 53 E., on the north side of Jack Creek (USGS Bull Run 15′ topographic quadrangle). A field examination failed to disclose any antimony minerals.

Island Mountain Mining District

The Island Mountain district, 76 miles north of Elko, has a recorded production of $19,039 (Granger and others, 1957, p. 75) from gold, silver, lead, and copper. A small amount of antimony has also been produced. The area is underlain by Paleozoic rocks which have been intruded by granodiorite. Numerous small mines and prospects are present along the borders of the intrusive.

Foss prospect

Location	NW¼ sec. 1, T. 44 N., R. 55 E.
Ownership	Prudencio Mendive (1955).
Production	None.
Base map	USGS Mt. Velma 15′ topographic quadrangle.

The Foss prospect is situated in the low hills just south of Sunflower Flat and Sunflower Reservoir near the head of Gold Creek, 5 miles west of the Gribble mine.

The prospect is developed by a 41-foot vertical shaft and a 46-foot adit with an 8-foot crosscut located approximately 400 feet east of the shaft.

At the adit, limestone and interbedded gray to black shale of the Hammond Canyon Formation, striking N. 45° E. and dipping 20° SE., is cut by a silicified dike of intermediate composition. A few hundred feet to the south, granite intrudes the sedimentary rocks.

A fault, striking N. 45° E. and dipping 50° NW., forms the footwall of the dike. Stibnite occurs as small pods, blebs, and single crystals up to 1 inch long scattered randomly through the dike and in quartz along the fault. White antimony oxides partially replace the stibnite. Powdery, yellow antimony oxide coats fractures in the rocks and cleavage planes in the stibnite. A grab sample from the stockpile at the adit assayed 6.21 percent antimony, a trace of gold, and 4 ounces of silver per ton.

Gribble Antimony mine

Other names	Winnie Quartz, Gribble Quartz, McKinnon Antimony, Star Metal.
Location	Sec. 29, T. 45 N., R. 56 E.
Ownership	Charles Gribble, of Elko (1957).
Production	11 tons antimony (metal).
Base map	USGS Rowland 15′ topographic quadrangle.

The Gribble Antimony mine is located on the southwest slope of Tennessee Mountain, a quarter of a mile northeast of the road along Big Bend Creek and 1½ miles northwest of the Gold Creek Ranger Station.

Fifteen tons of ore containing 41 percent antimony were shipped to Laredo, Texas in 1941–42. The mine was developed by a 35-foot inclined shaft with a 45-foot crosscut at the bottom. Extensive trenching and bulldozing have since covered the underground workings.

The mine is in thin-bedded limestone and interbedded phyllites of the Tennessee Mountain Formation of Middle Pennsylvanian Age. At the large trench these rocks strike N. 75° E. and dip 50°–55° NW.

The antimony-tungsten mineralization occurs in a wide, steeply north-dipping shear zone along a bedding plane fault which strikes N. 70° E. and dips 55° N. The 6- to 18-inch brecciated fault zone contains stringers and pods of stibnite and quartz, and stringers of calcite and scheelite. Yellow and white antimony oxides stain the stibnite-bearing stringers. Scheelite occurs along the same shear zone in three other faults and several hundred feet to the southwest on the adjoining claim. The scheelite is more abundant in the more calcareous shale beds.

White (unpublished data, U. S. Geol. Survey) stated that a stibnite vein containing up to 4 inches of high-grade ore was exposed in the inclined shaft, but could not be traced laterally. Small lenses of stibnite, rarely more than 2 inches thick, occur in the shales for 2 feet or more on both sides of the vein. The vein is 1 to 2 inches wide and contains approximately 15 percent antimony where it crosses the trench near the old shaft. The stibnite has been rather thoroughly oxidized. Small amounts of the red oxysulfide (kermesite?) are present, and other varicolored oxides of antimony are common.

Up to 2 percent lead and smaller amounts of zinc have been reported with the antimony. The wall rock along the various veins has been sericitized and argillized.

The table below shows the antimony and other values determined in five ore samples from the mine.

Scheelite occurs as small, white to tan grains, completely surrounded by stibnite. One 1- by 2- by 6-inch pod contained almost 85 percent scheelite. Closely connected pods form ore shoots several feet long. To the southwest, scheelite occurs without any associated stibnite. The paragenetic sequence of scheelite and stibnite could not be determined with any certainty from the textural relationships.

No.	Location	Description	Sb %	WO_3 %	Au oz.	Ag oz.
1	Shaft at 10 ft.	Kidney of ore	44.0	......	......	......
2	Shaft at 35 ft.	Kidney of ore	55.0	......	......	......
3	Crosscut, at 40 ft. from shaft	Grab sample, vein material	4.2	0.38	......	......
4	Crosscut, at 45 ft. from shaft	Grab sample, vein material	6.4	0.52	......	......
38	Dump	Grab sample, vein material	6.12	......	None	0.54

Rock Creek Mining District

The Rock Creek (Falcon) mining district is in northwestern Elko County, about 10 miles west of Tuscarora, in T. 40 N., Rs. 48 and 49 E. (see USGS Mt. Blitzen 15′ topographic quadrangle).

The total production is 4,865 ounces of silver and 14 ounces of gold from 31 tons of ore. Some prospecting for mercury has been done in recent years.

At the heads of Willow and Rock Creeks, a stock of granodiorite intrudes carboniferous quartzite. Rhyolite volcanic rocks cap the granodiorite and quartzite. Numerous intrusions of andesite cut the other rocks. The county rock in the district is principally andesite (Emmons, 1910, p. 62).

Falcon mine

The Falcon mine is near the head of Rock Creek, in sec. 13, T. 40 N., R. 49 E. (see USGS Mt. Blitzen 15′ topographic quadrangle). It was operated for silver from 1879 to 1881 (Emmons, 1910, p. 62) and is now owned by W. R. Maxwell.

Antimony occurs as pyrargyrite associated with pyrite in a brecciated and silicified zone in andesite. The brecciated rock has been recemented by quartz and chalcedony, occurring as comb and ribbon structures, with numerous vugs lined with short stubby quartz crystals. Blebs and small pods of pyrargyrite are scattered through the quartz, chalcedony, and silicified andesite. Blebs, single crystals, and small pods (up to half an inch across) of pyrite are distributed randomly through the chalcedony. A grab sample from the stockpile on the dump assayed 1 percent antimony, and 0.04 ounce of gold and 22.16 ounces of silver per ton.

Fisher prospect

Location .... Sec. 12, T. 40 N., R. 49 E.
Production .... None.
Base map .... USGS Mt. Blitzen 15′ topographic quadrangle.

The Fisher prospect is on Rock Creek 1 mile north of the Falcon mine, approximately 12 miles west of Tuscarora. Three adits and four trenches have been developed at the prospect. One adit is 20 feet long, the second 35 feet long, the third, now caved, probably was short.

The three adits follow a narrow silicified zone, striking N. 5° E., in andesite. The andesite has been brecciated and recemented by quartz and chalcedony. Veinlets of chalcedony contain numerous acicular needles of stibnite up to three-fourths of an inch long. Stibnite also occurs as single crystals in open fractures and vugs, as blebs up to one-fourth of an inch across, and as rosettes. Small blebs and cubes of pyrite are scattered through the chalcedony.

The stibnite commonly is replaced by both white and yellow antimony oxides. The white oxide is fibrous and forms pseudomorphs after stibnite. The yellow oxide occurs as pseudomorphs after stibnite and as powdery coatings along fractures.

Red Cow prospect

The Red Cow Creek prospect is at the head of Red Cow Creek in sec. 1, T. 40 N., R. 49 E., 3 miles due north of the Falcon mine (see USGS Mt. Blitzen 15′ topographic quadrangle). Stibnite has been reported at this prospect (oral communication, 1957, Louis Salet), but was not found during a field examination. A small amount of yellow antimony oxides with marcasite and arsenopyrite in quartz was found on the dump of a caved, vertical shaft.

Rock Creek prospect

Other names	Mountain View.
Location	Sec. 12, T. 40 N., R. 48 E.
Ownership	John Mayeroff, of Winnemucca (1957).
Production	None.
Base map	USGS Mt. Blitzen 15′ topographic quadrangle.

The Rock Creek prospect (fig. 11) is on the north ridge overlooking Rock Creek, 7 miles above the junction of the three forks of Rock Creek, and about 7 miles west of the Falcon mine. The mine is developed by four open cuts.

A brecciated and silicified zone, striking N. 40°–60° E., cuts the andesite country rock. Numerous quartz veinlets containing vugs lined with stubby quartz crystals are found in the silicified zone. Stibnite occurs as blebs up to one-eighth of an inch in length, needles, and radiating bladed aggregates (with blades up to 1 inch long). Tabular crystals of pyrite, and occasional arsenopyrite grains are scattered through the silicified zone. Botryoidal masses of cinnabar, apparently formed later than the stibnite, occur along fractures. A specimen of silicified breccia containing bladed stibnite assayed 11.33 percent antimony, 0.02 ounce per ton of silver and no gold. The stibnite commonly is at least partially replaced by fibrous white antimony oxide and earthy to vitreous yellow antimony oxide.

Other occurrences

Stibnite reportedly occurs in a prospect pit on a hillside at the head of a gulch above Rock Creek, in sec. 10 T. 40 N., R. 49 E., 2 miles west of the Falcon mine (W. R. Maxwell, oral communication, 1956), but could not be located during a field examination.

Other Occurrences in Elko County

Blue Ribbon-Boyce mine

Other names	Reid, Boyce, Antimony Ridge, Stibnite.
Location	NW¼ sec. 1, T. 44 N., R. 52 E.
Production	7 tons antimony (metal).
Base map	USGS Bull Run 15′ topographic quadrangle.

The Blue Ribbon-Boyce mine is located in the Van Duzer mining district near the head of Silver Creek, on the west side of the

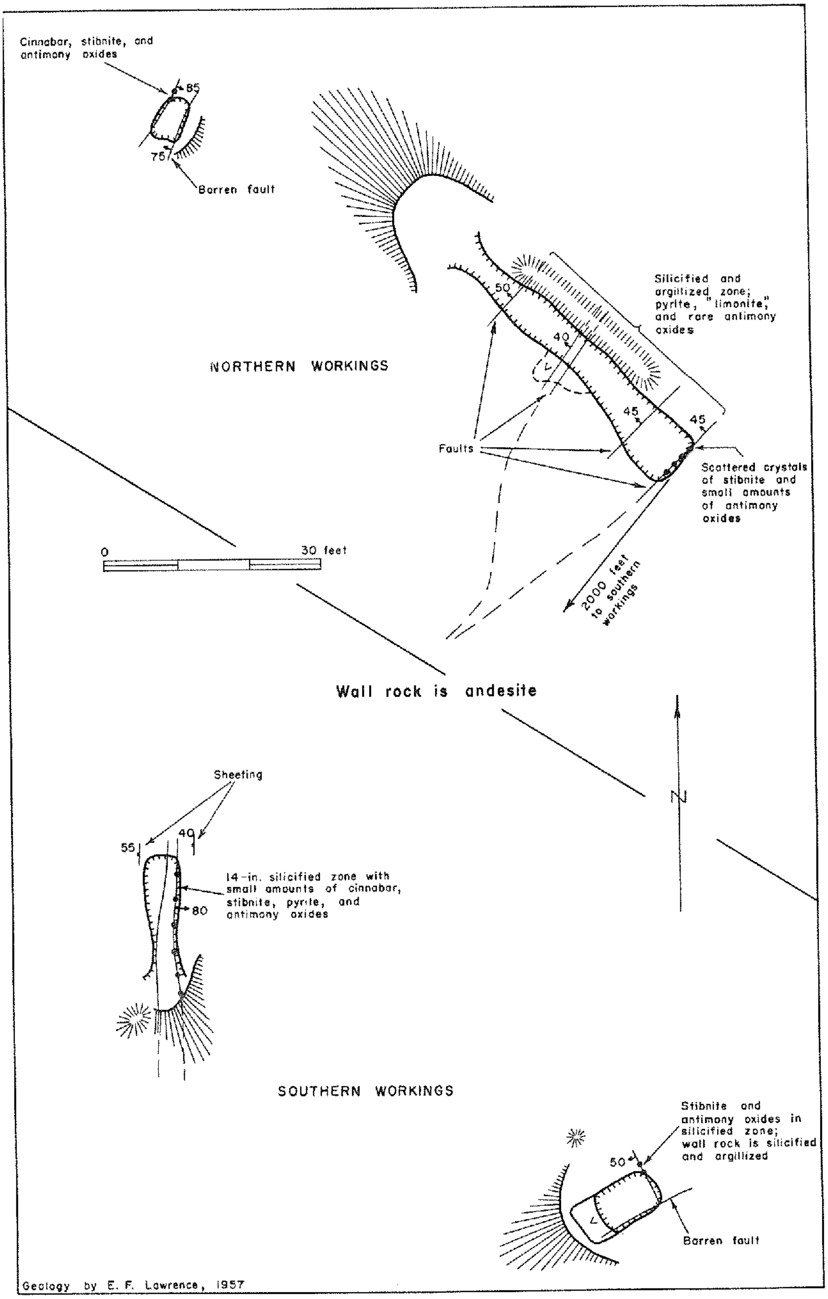

FIGURE 11. Geologic map of the Rock Creek prospect, Elko, County, Nevada.

creek three-fourths of a mile northwest of Pennsylvania Hill, one of the highest points in the Bull Run Mountains.

In 1940, 19 tons of ore averaging 36 percent antimony were shipped. The mine consists of a 35-foot inclined shaft (caved at 17 feet), a shallow shaft (partially caved), one short adit (open), and several prospect pits. At one time, the main group of workings were known as the Blue Ribbon mine, while the one shallow shaft, some 800 feet south of the other workings, was called the Boyce mine; later, however, both mines were worked as one unit.

The mine is in a body of granite which has intruded massive, gray, Pennsylvanian (?) limestone, the contact being 700 to 1,000 feet from the mine. The granite is gray, medium to fine grained, granular, and is composed principally of orthoclase and quartz with smaller amounts of plagioclase, hornblende, biotite, muscovite, magnetite, and chlorite.

Several veins cut the granite. One vein, which strikes N. 70° W. and dips 75° S., is exposed in the short adit southeast of the inclined shaft. This vein varies from 18 to 30 inches in width, and is composed of milky, massive to vuggy quartz containing stibnite in small pods, veinlets forming rough banding parallel to the vein walls, and single crystals disseminated through the vein. The stibnite is partially oxidized for a few feet below the surface, but most commonly is unoxidized and fresh looking. The footwall of the vein has been argillized for distances of 12 to 24 inches from the contact; the hanging wall may show up to one-fourth of an inch of clay.

A second vein was reported (White, unpublished data, U. S. Geol. Survey) 75 feet northwest of the inclined shaft, but no evidence of it was found except for some float. The small prospect pit in this area probably exposed this vein but is now caved.

A third vein is exposed in the 10-foot shaft 840 feet S. 15° W. of the inclined shaft. This vein strikes N. 85° W., dips 50° S., is 8 to 12 inches thick, and is composed of milky quartz containing approximately 5 percent antimony as small (¼–¾-inch) pods and veinlets of stibnite. A small amount of pyrite is scattered through the vein, but commonly is oxidized to limonite. The table below indicates the values of antimony, silver, and gold in two samples of ore from this mine.

No.	Description	Sb %	Au oz.	Ag oz.
46	8-inch vein	None	25.92	None
47	Grab sample, dump	7.37	5.60	Trace

The country rock is argillized for 12 to 24 inches on both sides of the vein. The orthoclase and plagioclase commonly are sericitized near the vein; the hornblende and biotite commonly are chloritized or sericitized.

Bootstrap mine

Other names	Antimony Pete, Antimony Ike, Boulder Creek, Antimony Creek.
Location	Secs. 3, 10, and 11, T. 36 N., R. 49 E.
Ownership	Marion Fisher and associates (1957).
Production	None.
Base map	U. S. 1:250,000 scale topographic map, McDermitt sheet.

The Bootstrap mine (fig. 12) is about 4 miles south of the Rossi barite mine on the west side of the Tuscarora Mountains, and 25 miles north of Dunphy.

Total production through November 1959 was $330,532 of gold. A load of antimony ore was hauled to Dunphy in 1914, but was never shipped.

The mine is developed by a 24-foot shaft and a 520-foot adit (caved at 60 feet). The shaft opens into a stope from which gold was mined. Two other shallow shafts are caved. Numerous trenches crosscut the dike in which the gold occurs. Considerable exploratory drilling has been done.

Ordovician to Pennsylvanian limestone, dolomitic limestone, and quartzite, generally striking N. 55° W. and dipping 30°–55° E., crop out at the mine. A dike cutting the sedimentary rocks can be traced for 3 miles (Marion Fisher, oral communication, 1958). Limestone in contact with the dike is hornfelsic and partially marbleized.

The dike is porphyritic with a fine-grained groundmass having a diabasic texture. Although highly altered and stained reddish-brown to brown, it probably is andesitic in composition. Completely sericitized relict lathes of plagioclase make up about 35 percent of the rock. Stubby relict grains, now completely argillized or sericitized, apparently were originally orthoclase. Biotite(?) has also been sericitized. Numerous minute pseudomorphs of limonite after pyrite are disseminated through the dike; numerous thin quartz veinlets containing vugs lined with stubby quartz crystals cut the groundmass. Assays indicate that the gold occurs in the dike, probably mainly in microscopic quartz veinlets and vugs. Although the antimony minerals are associated spatially with the gold ore, numerous analyses of the gold ore reveal only traces of antimony.

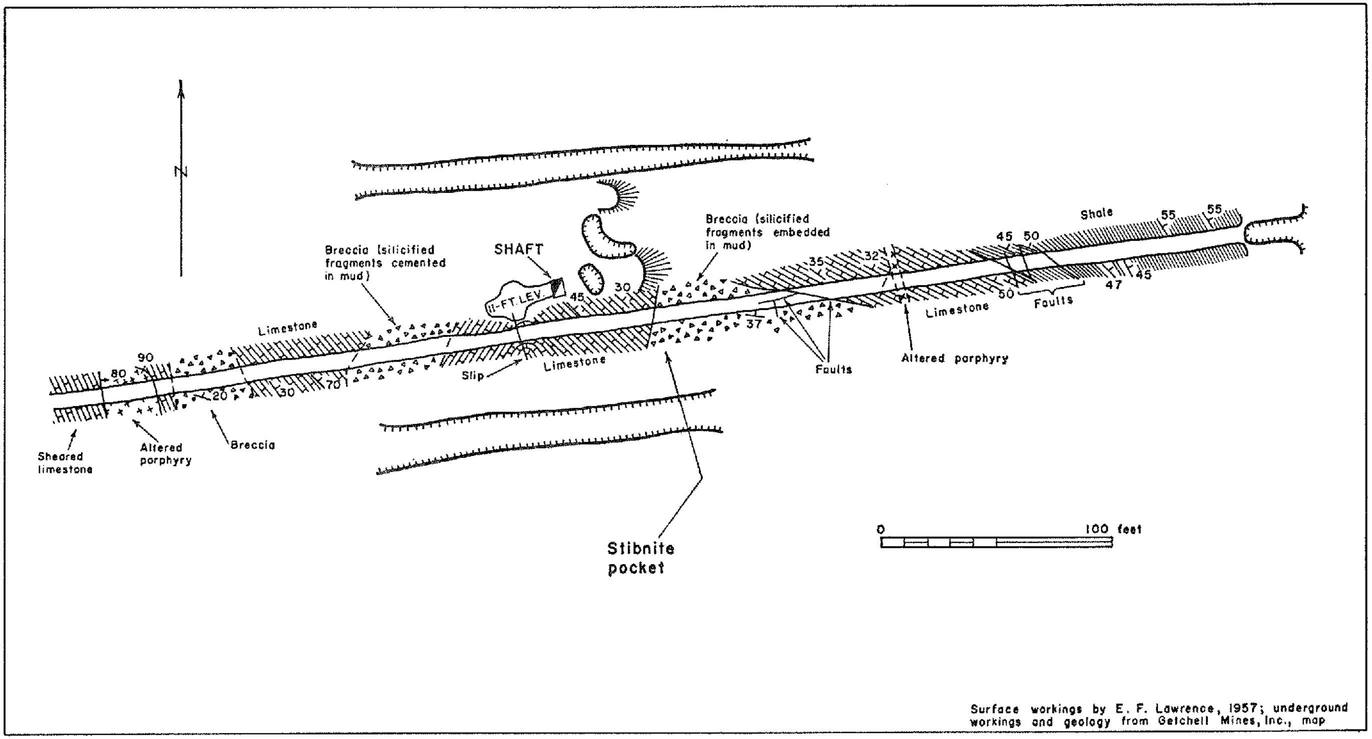

FIGURE 12. Geologic map of the Bootstrap mine, Elko County, Nevada.

The stibnite occurs as blebs, pods, and single crystals with quartz, calcite, and barite in a silicified zone on the east side of the dike at the upper shaft. Yellow antimony oxide is present as pseudomorphs after stibnite crystals in vugs, as powdery coatings along fractures, and as earthy masses. Stibnite is present also in a veinlike body in the adit directly below the upper shaft. This occurrence was inaccessible, but reportedly consisted of a vein 4 inches wide containing 1 to 3 inches of stibnite which is partially altered to yellow and white antimony oxides. The wall rock apparently was silicified limestone.

Analyses of a grab sample from the Bootstrap mine showed 9.40 percent antimony, a trace of gold, and 6.08 ounces of silver per ton.

Cornucopia mining district

The Cornucopia mining district is situated in sec. 18, T. 42 N., R. 51 E., 12 miles west of Deep Creek (see U. S. 1:250,000 scale topographic map, McDermitt sheet). Antimony was reported in gold ore of the district (Aune, unpublished data, U. S. Bureau of Mines). The country rock consists of rhyolite intruded by andesite. Veins, striking N. 78° E. and dipping 83° N., consist principally of quartz with some argentite, tetrahedrite, pyrargyrite, and pyrite. Cerargyrite, pyromorphite, and yellow antimony oxide occur near the surface.

Delano mine

Antimony reportedly occurred at the Delano mine, sec. 28, T. 44 N., R. 68 E., in the northeastern corner of Elko County (see U. S. 1: 250,000 scale topographic map, Wells sheet). The geology of this area has been described by Granger and others (1957, p. 48). Antimony occurs in tetrahedrite and pyrargyrite but these minerals are present only in minor amounts and are not potential sources of antimony.

Good Hope mine

Other names	Heffner.
Location	Sec. 16, T. 41 N., R. 49 E.
Ownership	Good Hope Investors, Inc.
Production	None.
Base map	USGS Mt. Blitzen 15′ topographic quadrangle.

The Good Hope mine (fig. 13) is in the Good Hope mining district on Chino (Four Mile) Creek, 6 miles north of Rock Creek.

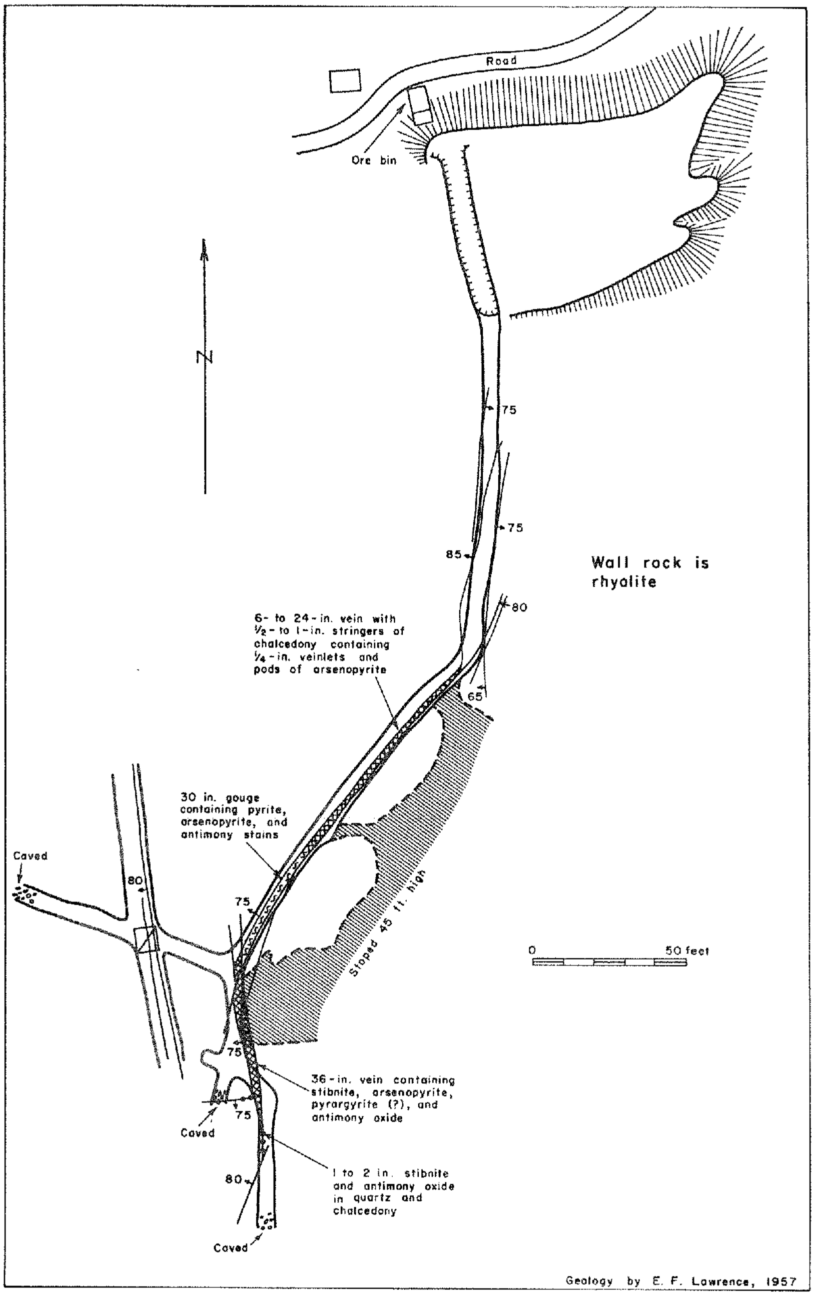

FIGURE 13. Geologic map of the Good Hope mine, Elko County, Nevada.

Mine openings include two shafts, now caved, and an adit with several winzes, drifts, and crosscuts.

Light-colored, argillized, and sericitized rhyolite flow breccia crops out at the mine (Emmons, 1910, p. 65). The main vein strikes N. 10° W. and dips 70° W., and is cut and offset by a cross fault which strikes N. 40° E. and dips 75° NW. Gouge, arsenopyrite, pyrite, and traces of yellow antimony oxide occur in the cross fault. Up to 36 inches of vein material occur along the main vein beyond the cross fault. The vein consists principally of quartz and chalcedony with some stibnite, arsenopyrite, pyrite, and rounded blebs of pyrargyrite. A sample of this material assayed 14.61 percent antimony, 7.56 ounces of silver per ton, and a trace of gold. Stibnite and antimony oxides occur in 16 inches of the 35-inch vein of the hanging wall at a distance of 240 feet from the portal. This vein splits into a 12-inch footwall zone and a 4-inch hanging wall zone, each containing quartz, stibnite, and antimony oxides.

Stibnite occurs as blebs, pods up to 6 inches across, veinlets, rosettes, and single crystals. Single bladed crystals of stibnite commonly line vugs in quartz. The stibnite commonly is partially altered to yellow and white antimony oxides. The yellow oxide is powdery to earthy, and occurs as coatings along fractures and as pseudomorphs after stibnite. A white oxide less commonly replaces stibnite.

Hunter prospect

Other names	Merrimac, Silver Tip, Lone Mt., Reincarnation, Malachite, Lone Wolf.
Location	Sec. 2, T. 37 N., R. 53 E.
Ownership	E. F. Hunter (1957).
Production	None.
Base map	U. S. 1:250,000 scale topographic map, Wells sheet.

The Hunter prospect is at the head of McClelland Creek on the south flank of Lone Mountain.

Twelve tons of lead-silver-antimony ore were shipped unprofitably in 1921(?) (Mrs. T. E. Hunter, oral communication, 1957). The claims are developed by two adits and several prospect pits and trenches. The adits are partially caved.

Limestone of the Devonian(?) eastern facies McClellan Creek sequence crops out at the mine. It is part of the lower plate of the thrust fault mapped by Lovejoy (1959, p. 539), and is overlain by Ordovician chert and shale in the upper plate of the thrust fault. The Nannies Peak quartz monzonite has intruded the Devonian(?) limestone near the mine.

Several copper-lead-silver mines, including the Hunter prospect, occur along the western flank of Lone Mountain. Stibnite reportedly occurs at the Hunter prospect, associated with galena and pyrite, as small blebs and pods forming large lenses (E. F. Hunter, oral communication, 1957).

Mendive prospect

Antimony reportedly (Prudencio Mendive, oral communication, 1958) occurs in the Mendive (McDonald Creek) prospect, which is in sec. 6, T. 46 N., R. 55 E., along the north side of McDonald Creek, 17 miles northeast of Mountain City (see USGS Mountain City 15′ topographic quadrangle). A small amount of yellow antimony oxide is present, probably having been formed by the oxidation of an antimony-silver sulfosalt.

Merritt Mountain prospect

Antimony reportedly (Mrs. W. Coffman, oral communication, 1958) occurs in the prospect of the Merritt Mountain Mining Co., on the northern flank of Merritt Mountain near the headwaters of Merritt Creek in secs. 11 and 12(?), T. 46 N., R. 54 E. (see USGS Mountain City 15′ topographic quadrangle). Grab samples from the dump contain galena, pyrite, and a small amount of yellow antimony oxide.

Tuscarora mining district

Silver-antimony sulfosalts reportedly occur in the Tuscarora mining district. Stephanite and pyrargyrite apparently are the only antimony minerals present, and these occur only in small amounts (Emmons, 1910, p. 59; Granger and others, 1957, p. 163; and Nolan, 1936, p. 31).

Earl Phillips (oral communication, 1957) reports a deposit of stibnite north of Tuscarora in the Champion mine area, sec. 11 T. 40 N., R. 51 E. A search failed to reveal any stibnite, and only a small amount of yellow antimony oxide.

Valdez prospect

Other names	Gold prospect, Pyramid mine.
Location	Sec. 4, T. 46 N., R. 61 E.
Ownership	Pyramid Tungsten, Inc.
Production	None.
Base map	USGS Elk Mountain 15′ topographic quadrangle.

The Valdez prospect is in the Elk Mountain mining district on the west flank of White Elephant Butte, 16 miles west of Contact.

Shale, limestone, quartzite, and slate have been domed and intruded by a stock of granodiorite, exposed over a ¾- by 1½-mile area (Granger and others, 1957, p. 58). The mine is developed by two pits. Considerable stripping and mining have been done on the contact 500 feet to the southeast for tungsten (scheelite) and molybdenum.

The two pits are along a silicified zone up to 60 inches wide, striking N. 15° E. and dipping 78° E. This zone parallels the granodiorite-limestone contact, cutting the limestone which here strikes N. 60° W. and dips 20°–60° NW. A quartz vein, 12 to 18 inches wide, occurs in the silicified zone. Pods, small blebs, and single crystals of stibnite are scattered through the quartz vein, the silicified zone, and country rock along the edges of the zone. A small amount of pyrite and arsenopyrite are intermixed with the stibnite. Stibnite commonly is partially replaced by fibrous or earthy white antimony oxide and powdery to earthy yellow antimony oxide. A sample of the vein 18 inches wide assayed 0.55 percent antimony and 0.68 ounce per ton of silver. No gold was found.

ESMERALDA COUNTY

B. & B. mine

The B. & B. mine is located in sec. 1, T. 1 S., R. 33 E., on the west slope of the White Mountains (see U. S. 1:250,000 scale topographic map, Mariposa sheet). Up to 1943, 2,659 flasks of mercury had been produced. Cinnabar occurs in an opalite blanket that has been formed by alteration of rhyolitic tuff and flows and the andesite breccia. The geology has been described by Bailey and Phoenix (1944, p. 67–70). Antimony oxysulfide (kermesite?) has been found in the central part of the opalite blanket as pulverulent to earthy coating. No antimony sulfides have been found, although a small amount of stibnite is known in the Red Rock mine, a few miles to the southwest.

Castle Rock prospect

The Castle Rock prospect is in the Gilbert mining district in secs. 21 and 28, T. 3 N., R. 38 E., in the Monte Cristo Mountains, (see U. S. 1:250,000 scale topographic map, Tonopah sheet). Originally located as a gold prospect, it was relocated in 1928 as a mercury prospect (Bailey and Phoenix, 1944, p. 75). In 1959, F. V. Bovard of Mina was the owner.

Cinnabar occurs as small veinlets in silicified andesite tuff. A small amount of stibnite occurs in a breccia zone in the slope above the mercury deposit. According to Fred Gilbert (oral communication, 1958) there are no other antimony occurrences in the area.

Florence mine

Schrader (unpublished data, U. S. Geol. Survey) stated that, "At Columbia, just north of Goldfield, the stibnite was mined for its silver content." Aune (unpublished data, U. S. Bureau of Mines) also reported the occurrence of antimony at Columbia in secs. 35 and 36, T. 2 S., R. 42 E. (see USGS Goldfield 15′ topographic quadrangle). Ransome (1909, p. 108) listed polybasite, goldfieldite, and famatinite as the common sulfantimonites found in the Goldfield mining district.

Gilbert mining district

The Gilbert mining district includes the eastern part of the Monte Cristo Range in sec. 15, T. 4 N., R. 38 E., (see U. S. 1:250,000 scale topographic map, Tonopah sheet). Aune (unpublished data, U. S. Bureau of Mines) reported antimony in the Carrie and Mammoth mines.

Bindheimite reportedly occurs in the Carrie mine (Ferguson, 1927, p. 139). Fred Gilbert stated (oral communication, 1958) that stibnite occurs with galena, sphalerite, molybdenite, and scheelite on the 210-foot level in the inclined shaft; elsewhere in the mine stibnite is rare.

Ferguson (1927, p. 141) mentioned the presence of pyrargyrite at the Mammoth mine. A small amount of stibnite was found on the adit level (Fred Gilbert, oral communication, 1958). Mr. C. Cox (oral communication, 1958) stated that antimony ore occurs in an open cut on the ridge above the mine.

Mattmueller mine

The Mattmueller (Roanoke, E. B. & R., Elsie Belle) mine on the south flank of Palmetto Peak is in sec. 20, T. 5 S., R. 40 E., approximately 1 mile northwest of Lida (see USGS Lida 1′ topographic quadrangle). It is developed by an adit which cuts the vein at 120 feet and a 115-foot drift along the vein. The vein strikes N. 55° E. and dips 40°–50° SE., is 12 to 48 inches wide, and consists of quartz, calcite, and gouge. The country rock is phyllite, sandstone, and limestone. In the drift, 210 feet from the portal, a 10-foot, fine-grained diorite dike, striking N. 15° W. and dipping 50° NE., offsets the vein. No antimony minerals were noted during the field examination in 1958; three samples taken across the vein assayed 0.00, 0.01, and 0.06 percent antimony.

Mickspot mine

Other names	Nora Francis, New Dream
Location	Sec. 3(?), T. 6 N., R. 38 E.
Ownership	Lee Hand and Neil Doherty (1958).
Production	Small.
Base map	U. S. 1:250,000 scale topographic map, Tonopah sheet.

The Mickspot mine (fig. 14) is along the east flank of the Monte Cristo Range 15 miles north of Crow Springs. During World War II a small amount of ore was shipped. The mine is developed by two 35-foot shafts (inclined 75°) and several small open cuts.

Quartzites and cherts of the Triassic Excelsior Formation, generally striking N. 30° W. and dipping 55° SW., crop out at the mine. A vein, striking N. 30° W., and dipping 60°–70° SW., cuts the Excelsior Formation. It is 6 to 14 inches wide and consists of brecciated chert recemented by quartz. Some small pods, veinlets, and single crystals of stibnite occur with the quartz as well as small amounts of pyrite, arsenopyrite, chalcopyrite, and green and blue copper carbonates. The stibnite has been oxidized to powdery or vitreous, yellow, orange, and white antimony oxides. Arsenopyrite commonly has been leached, with cellular boxworks remaining; the yellow, fluffy oxides have been redeposited short distances away from the boxworks. Analyses of antimony and other values found in ore of the Mickspot mine are shown below:

No.	Location	Description	Sb %	Au oz.	Ag oz.	Se %
211	Dump	Grab sample	35.14	None	0.26	Trace
212	Shaft at 32 ft.	6-inch vein	0.9	0.70	2.04	......
213	Stockpile	Grab sample	0.6	0.42	2.56	Trace

Red Rock mine

The Red Rock mine is in the Fish Lake Valley mining district on the eastern flank of the White Mountains in sec. 18, T. 1 S., R. 34 E., southwest of Coaldale, (see U. S. 1: 250,000 scale topographic map, Mariposa sheet). Stibnite and stibiconite are associated with cinnabar, quartz, barite, and clay in veinlets in interbedded phyllites and marble of a roof pendant of Paleozoic metamorphic rocks (Bailey and Phoenix, 1944, p. 72).

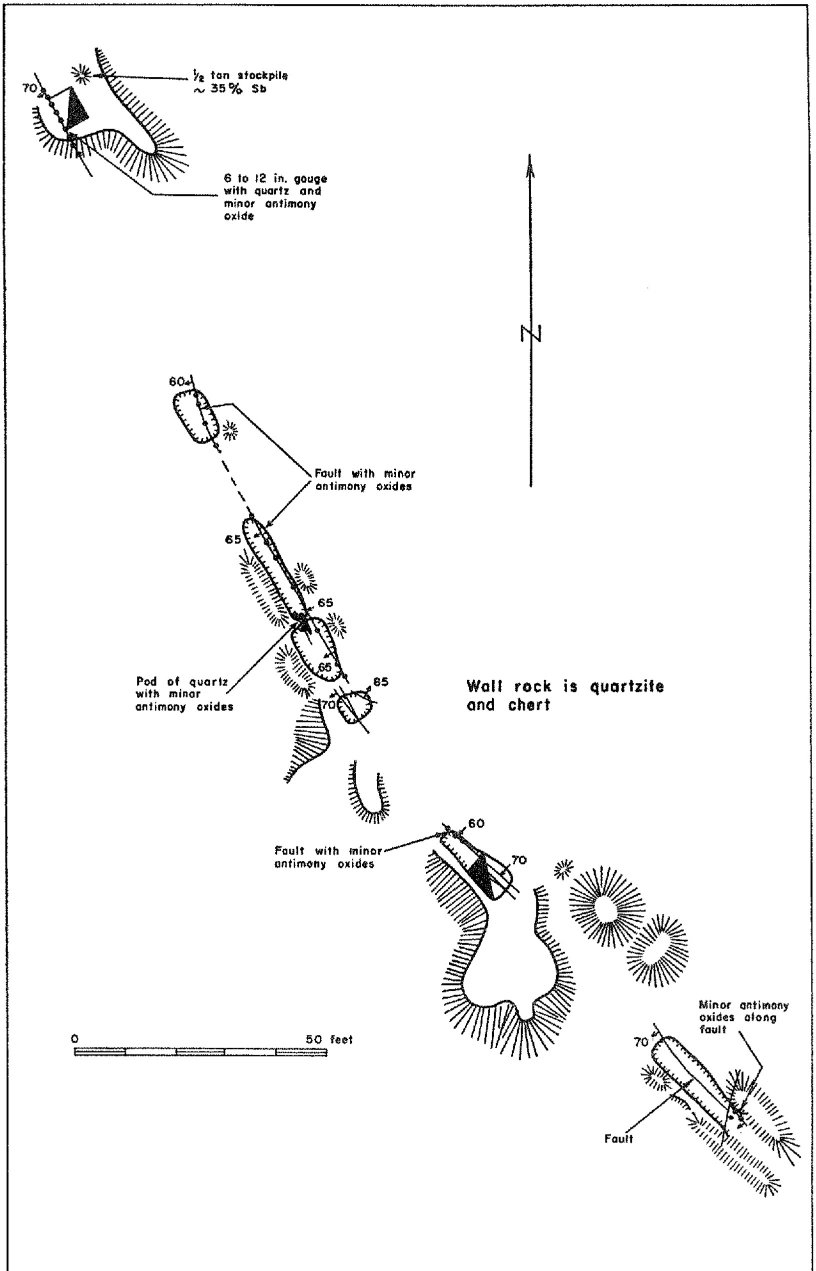

FIGURE 14. Geologic map of the Mickspot mine, Esmeralda County, Nevada.

Riek-George prospect

In 1942 James Cullen of Mt. Montgomery Station, Nevada, was reported (White, unpublished data, U. S. Geol. Survey) to have a prospect containing stibnite approximately 10 miles east of Rock Hill Station on the abandoned Tonopah and Goldfield Railroad. Aune (unpublished data, U. S. Bureau of Mines) reported a deposit owned by Carl Riek and located 19 miles northeast of Coaldale, which according to J. Huffman (oral communication, 1962) is probably the same as Cullen's prospect. Huffman reported only a minor occurrence of stibnite. This property was inaccessible because of snow at the time of the writer's visit.

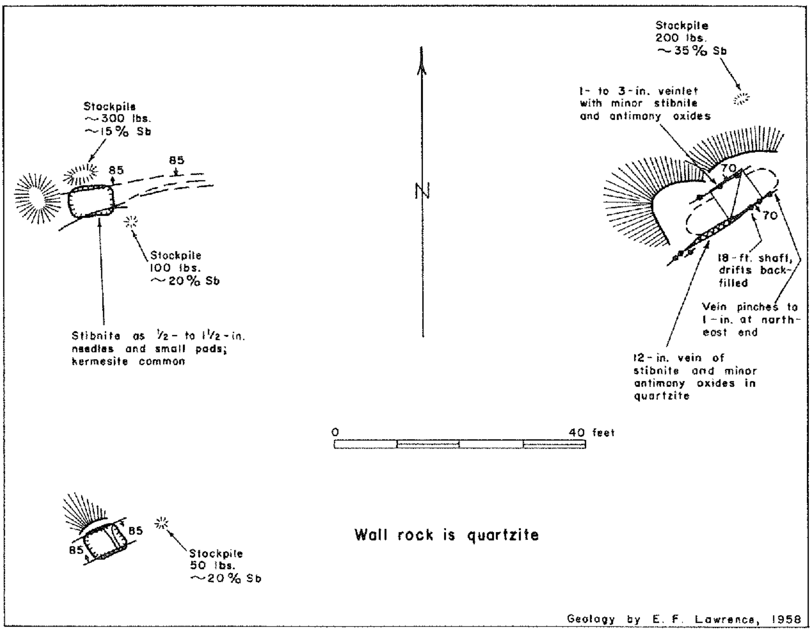

FIGURE 15. Geologic map of the Blue Eagle mine, Eureka County, Nevada.

EUREKA COUNTY

Blue Eagle mine

Other names .... Villanueva.
Location .... Sec. 30, T. 23 N., R. 50 E.
Ownership .... Philbut Etchevary.
Production .... None.
Base map .... USGS Roberts Creek Mt. 15′ topographic quadrangle.

The Blue Eagle mine (fig. 15) is in the Antelope mining district at the headwaters of Meadow Creek on the west flank of the Roberts Mountains 5.2 miles east of the 3-Bar Ranch. Workings consist of an 18-foot inclined shaft and two shallow pits.

Dark-brown to black quartzite at the mine is cut by a 1- to 12-inch vein, which strikes N. 55° E. and dips 70° SE. The vein contains blebs, veinlets, single crystals, and small pods (up to 12 inches) of stibnite in quartz and gouge. A second vein, 1 to 3 inches wide, parallels the other and contains a small amount of stibnite. The quartzite between the two has been brecciated and impregnated with pods and veinlets of stibnite. The shallow pit to the southwest exposes a vein striking N. 75° E. and dipping 85° NW., which may be a continuation of that at the shaft. It contains a small amount of stibnite as veinlets, small pods, and single crystals.

The stibnite has been partially altered to kermesite(?) and yellow and white fibrous antimony oxides. The yellow oxides also occur as resinous to powdery coatings in fractures. The antimony oxides appear to be residual and are concentrated along fractures.

The following table shows analyses of two ore samples from the Blue Eagle mine.

No.	Description	Au oz.	Ag oz.	Sb %	Se %	Pb %
216	12-inch quartz vein	None	0.06	16.10	Tr.	None
217	Stockpile at shaft	None	0.22	38.92	Tr.	None

Cortez mining district

Antimony reportedly occurs in the Cortez mining district (Aune, unpublished data, U. S. Bureau of Mines) on the flanks of Mt. Tenabo in the Cortez Range, 35 miles south of Beowawe (see USGS Cortez 15′ topographic quadrangle). Emmons (1910, p. 104) reported stibnite, stromeyerite, and tetrahedrite in the ores of the Garrison mine and other mines along the west flank of Mt. Tenabo, and reported stibnite, tetrahedrite, and stephanite with quartz, calcite, galena, sphalerite, pyrite, chalcopyrite, ruby silver, and argentite in mines along Mill Creek on the east flank of Mt. Tenabo, 2 miles to the northeast. The only production of antimony has been as a by-product of the smelter.

Mineral Hill mining district

Antimony occurs (Aune, unpublished data, U. S. Bureau of Mines) in the Mineral Hill mining district on the west flank of the Sulphur Springs Range, 35 miles south of Carlin in secs. 3 and 10, T. 26 N., R. 52 E. (see USGS Mineral Hill 15′ topographic quadrangle). This area has been described in detail by Emmons (1910, p. 95) and Vanderburg (1938, p. 51). Antimony occurs as tetrahedrite, polybasite, and stephanite.

Morning Glory mine

The Morning Glory mine is in the Lynn mining district in sec. 13, T. 35 N., R. 50 E., 21 miles northwest of Carlin (see USGS 1:250,000 scale topographic map, McDermitt sheet). This probably is the occurrence listed as the Maggie Creek or Schroeder mine by Aune (unpublished data, U. S. Bureau of Mines). Stibnite reportedly (private report, 1942) occurs as lenses in a quartz vein associated with barite. The vein is exposed for 200 to 300 feet.

Safford mining district

Emmons (1910, p. 111) stated that stibnite occurs in the Zenoli mine, 1 mile southeast of Barth on the Southern Pacific Railroad, in secs. 17 and 18, T. 31 N., R. 51 E. (see USGS Beowawe 15′ topographic quadrangle). Vanderburg (1938, p. 60) mentioned that smelter returns on one shipment of 20 tons showed 0.8 percent antimony and 21.2 ounces of silver per ton. Field examination for this study failed to locate any antimony minerals.

Stibnite prospect

Other names	Affranchino.
Location	Sec. 9, T. 18 N., R. 53 E.
Ownership	Ernest Affranchino (1955).
Production	Small shipments reported.
Base map	USGS Bellevue Peak 15′ topographic quadrangle.

The Stibnite prospect is in the Eureka mining district on the west flank of Prospect Mountain along the Spring Valley road 7 miles south of Eureka and 200 feet south of the Dugout mine. The prospect is developed by five open cuts and a shallow shaft. The upper workings are about 700 feet S. 35° E. of the lower workings (fig. 16).

Gray to black (crystalline limestone of the Ordovician Pogonip Formation, which generally strikes northwest, crops out at the prospect (Nolan and others, 1959). The workings are in a silicified zone in the limestone.

Near the north end of the prospect, a silicified zone up to 20 feet wide in the lower workings strikes N. 80° E. and dips 80°–85° W.; in the upper workings to the south the zone strikes N. 40° W. and dips 65° NE. The silicified zone includes minor calcite. Small pods up to 5 inches across, veinlets, and single crystals of

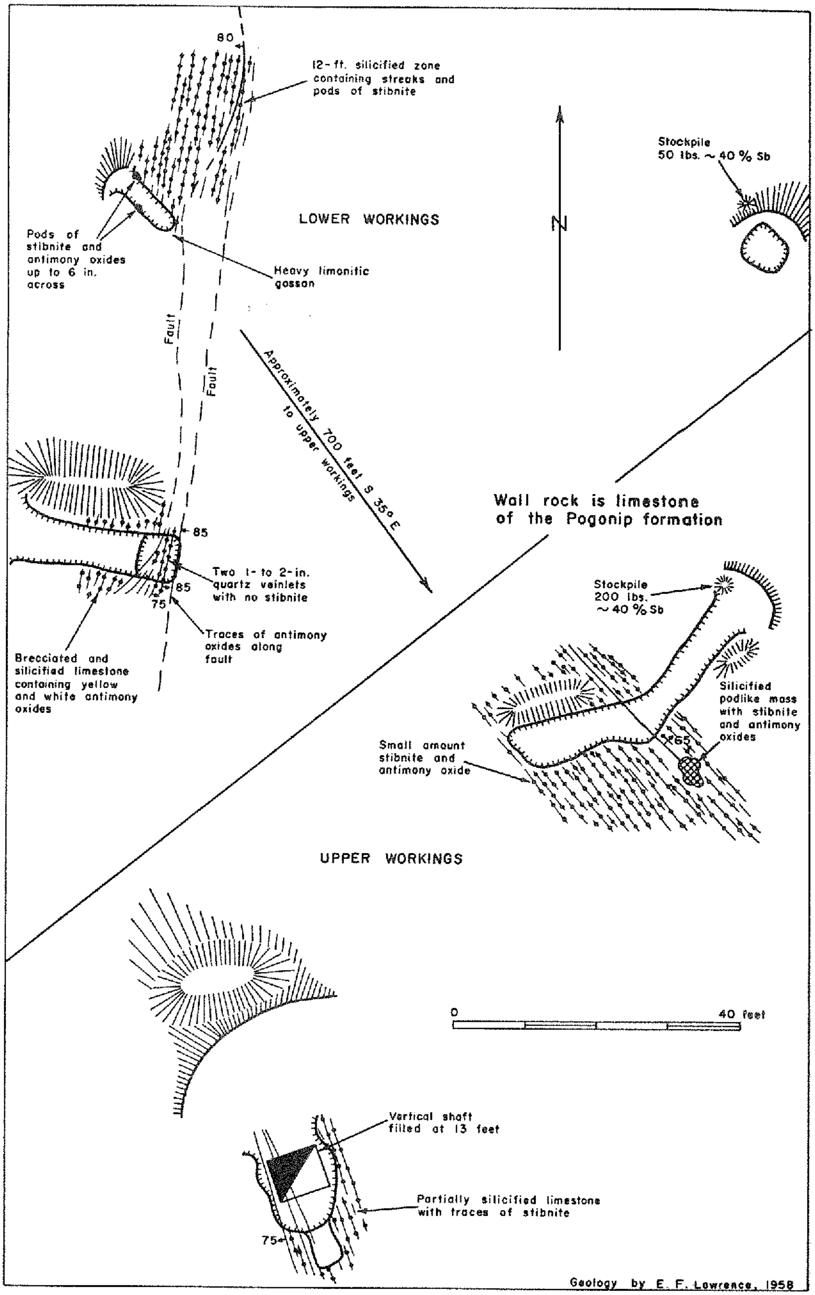

FIGURE 16. Geologic map of the Stibnite prospect, Eureka County, Nevada.

stibnite occur in the zone and as replacements in adjacent limestone; in places enough stibnite is present in the limestone to constitute ore. Small pods and blebs of tetrahedrite are associated with the stibnite in the lower pits. Pyrite occurs sporadically throught the silicfied zone. A grab sample from the 200-pound stockpile at the prospect assayed 17.57 percent antimony, 0.96 ounce of silver per ton, and no gold or selenium.

In the Dugout mine across the wash to the south, stibnite is interspersed with fine granular tetrahedrite and pyrite. Stibnite and tetrahedrite apparently were deposited simultaneously. Since the workings are caved, the textural relations were derived from material found on the dump.

At the Stibnite prospect, the antimony sulfide has been partially oxidized. The white oxide occurs most commonly as fibrous pseudomorphs after bladed stibnite, and less commonly as powdery coatings along fractures. The yellow oxide occurs around the margins and along cross fractures extending out from the white oxide pseudomorphs; it is common as vitreous, resinous to earthy coatings in fractures around pods of stibnite, and as a constituent of the limonitic gossan. Locally blue and green copper carbonates stain the white antimony oxide.

Young prospect

Other names	Slugger.
Location	Sec. 22(?), T. 18 N., R. 53 E.
Ownership	W. B. Young, of Elko (1960).
Production	None.
Base map	USGS Pinto Summit 15′ topographic quadrangle.

The Young prospect is located in the Eureka mining district on the southeast side of Prospect Mountain in a saddle between Ratto and Rocky Canyons and half a mile south of the Oswego mine. The prospect is developed by three pits and a 35-foot inclined shaft (fig. 17).

Limestone and dolomite crop out in the vicinity (Nolan and others, 1959). A shear zone 2 to 24 inches wide, striking N. 70° W., and dipping 35°–40° S., cuts the limestone. Pods, veinlets, and individual crystals of stibnite occur in the shear zone. In the inclined shaft, one exceptionally large pod, 12 to 24 inches thick and 60 inches long, contains approximately 50 percent stibnite. The sulfide has been oxidized to white, yellow, and green antimony oxides, occurring as halos around kernels of stibnite, and as powdery coatings along fractures.

The silicified limestone along the shear zone forms a prominent outcrop. This silicified zone is similar to the 10- to 12-foot silicified zone in the Prospect Mountain antimony prospect 2½ miles to the northwest in Dugout Canyon, sec. 9, T. 18 N., R. 53 E. The silicified zones at the two prospects may be parts of the same fracture zone, as suggested by their alignment and similar trends.

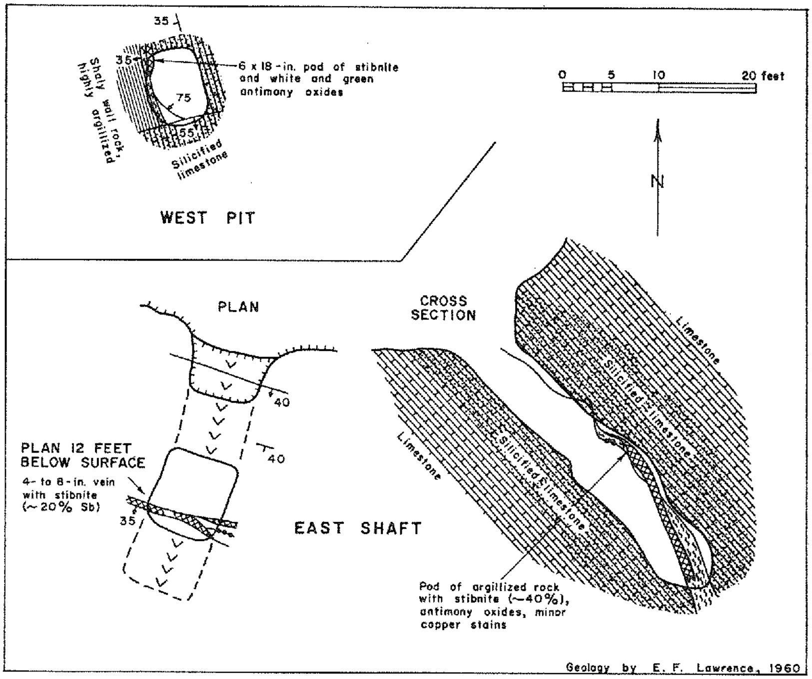

FIGURE 17. Geologic maps and section of the Young prospect, Eureka County, Nevada.

HUMBOLDT COUNTY

National Mining District

The National mining district is on the western slope of the Santa Rosa Range, 70 miles north of Winnemucca (see U. S. 1:250,000 scale topographic map, McDermitt sheet), in T. 46 N., R. 39 E. Approximately $4 million worth of gold and some silver has been produced.

Lindgren (1915) has described the geology in some detail. Tertiary flows cover much of the district with basalt predominating and rhyolite, trachyte, and latite in subordinate amounts.

These volcanic rocks overlie Triassic phyllites and quartzites. Numerous rhyolite dikes, commonly trending north, as well as basalt dikes, and rhyolite and basalt plugs, intrude the flows. Narrow fissure veins, trending north and dipping steeply east or west, cut the Tertiary rocks. The veins contain banded, vuggy quartz with lesser stibnite, pyrite, chalcopyrite, arsenopyrite, pyrargyrite, marcasite, sphalerite, galena, realgar, and orpiment. Cinnabar occurs in at least one vein. The veins are most noteworthy for their silver except for the unique gold ore shoot at the National mine (see below).

Stibnite is the most abundant sulfide, occurring in almost every vein that has not been highly oxidized. Stibnite-bearing veins commonly are vuggy, have large open cavities, and are poor in gold and silver. Lindgren (1915, p. 32) thought that the symmetrical banding and vuggy structure of the veins, and their composition—fine-grained quartz, scarcity of pyrite, constant presence of stibnite, and occurrences of cinnabar—indicated that the veins were formed near the surface by ascending hot water. Lindgren (1915, p. 45) also mentions secondary stibnite ". . . deposited from cool solutions long after the vein had been formed. . . . the presence of much marcasite, taken in connection with the scarcity of primary pyrite, might indicate deposition by weak ascending solutions."

Auto Hill

Auto Hill is somewhat more than half a mile west of the National mine, in sec. 28, T. 46 N., R. 39 E. A 50-foot rhyolite dike crops out in the wash to the west. Lindgren (1915, p. 47) noted that small quartz veinlets containing stibnite, bismuth, cinnabar, native silver, pyrargyrite, chalcopyrite, covellite, and minor yellow antimony oxides are associated with the dike. Ore from these veinlets was rich in silver, but contained little gold. The Blum shaft was sunk on a well-defined vein in the dike striking N. 8° E. and dipping 70° W. The vein consists of clay gouge and quartz stringers up to 10 inches wide. Cinnabar was found in the gouge 30 feet below the surface, and as 1- to 2-inch veinlets on the 60-foot level. Pyrite, galena, sphalerite, and tetrahedrite also are present.

Caustin-Bankers-Diffenbach area

Three shafts were sunk and an adit was driven to intersect the National vein half a mile southeast of the National mine in the north part of sec. 34, T. 46 N., R. 39 E. The Caustin inclined shaft is 180 feet deep; the Bankers inclined shaft is 300 feet deep; and the Diffenbach shaft is 300 feet deep. These shafts were sunk on a quartz vein in altered basalt containing marcasite, pyrargyrite, and stibnite. Stibnite occurs as partially oxidized needles up to 1 inch long scattered through chalcedony and quartz, as needles on quartz crystals lining vugs, and as small pods in crudely banded quartz. A grab sample of ore from the dump assayed 4.36 percent antimony, a trace of selenium, and 0.06 ounce of gold and 23.18 ounces of silver per ton.

Chefoo tunnel

The Chefoo tunnel is on the south side of Round Hill three-fourths of a mile west of the National mine in the center of sec. 33, T. 45 N., R. 39 E., and extends N. 55° W. for 416 feet to a vein. A drift follows the vein 45 feet south and 20 feet north. The wall rock is basalt. The vein, here 4 to 5 inches in width, occurs in a 3-foot zone of soft, white rock. Lindgren (1915, p. 47) stated that the vein is composed of:

> ". . . silicified and pyritic material, made up of fragments of country rock, and containing also small crystals of arsenopyrite, and between these fragments are crusts of fine quartz crystals resting upon narrow bands of pyrite, zinc blende and chalcopyrite. In the vugs delicate capillary needles of stibnite rest upon the quartz crystals. This stibnite and some marcasite are the latest minerals formed . . . Assays of specimens of good-looking ore from this locality gave 20 cents in gold and 16 ounces of silver to the ton."

These specimens contained a little stibnite which Lindgren (1915, p. 45) considered to be secondary.

Indian Valley tunnel

The Indian Valley tunnel is one-fourth of a mile northeast of the National mine, in sec. 27, T. 46 N., R. 39 E. The tunnel extends 500 feet south along a vein. The vein is up to 5 feet wide and consists of fragments of altered rhyolite, some quartz stringers, and locally abundant stibnite, cementing fragments of rhyolite with finely divided pyrite. A little kaolinite was the only other mineral observed with stibnite. Handpicked stibnite specimens contained a trace of gold and less than one ounce of silver per ton. A crosscut from the tunnel cuts basalt which contains several quartz veins with pyrite, stibnite, and calcite (Lindgren, 1915, p. 50).

National mine

The National mine is located 2 miles northeast of the ghost town of National, in sec. 34, T. 46 N., R. 39 E. A large gold-bearing ore shoot, the only one found in the district, was mined.

Lindgren (1915, p. 42) states that:

> "The isolated position of this wonderful ore shoot, in a district of quartz-stibnite veins poor in gold and silver, is surely remarkable. The gold is strictly of primary origin, practically none of it having been dissolved and reprecipitated. The veins appear to belong to one and the same epoch of mineralization, the gold shoot being a local development upon one of the normal stibnite veins."

Parallel veins near this National vein are also of the stibnite type.

Radiator Hill

Radiator Hill is one-fourth of a mile southwest of National. The vein strikes N. 10° W., is nearly vertical, and consists of stringers of comb quartz, with radial stibnite along the walls and small specks of tetrahedrite in the quartz. The ore is oxidized at the surface, but fresh stibnite occurs a few feet below the surface. An assay of a sample of vein quartz containing stibnite gave a trace of gold and 12 ounces of silver per ton. (Lindgren, 1915, p. 46).

Round Hill

Several adits, just north of the Chefoo tunnel, were driven into Round Hill to explore irregular quartz veins in decomposed basalt. The banded veins, 4 to 5 inches wide, consist of stibnite, pyrite, marcasite, sphalerite, chalcopyrite, arsenopyrite, and tetrahedrite. Lindgren (1915, p. 47) stated that the stibnite occurs as small needles in quartz vugs. Marcasite lines the vugs.

Bell group

Other names	Bell-Ward, Ward & Bell, Buckskin National, Norman Bell claims.
Location	Sec. 11, T. 45 N., R. 39 E.
Ownership	Buckskin National Gold Mining Co.
Production	None.
Base map	U. S. 1:250,000 scale topographic map, McDermitt sheet.

The Bell group of claims is 3 miles southeast of the main group of mines on the east slope of Buckskin Mountain.

Bell & Ward claims (Buckskin National). Lindgren (1915, p. 50) stated:

> "The Bell & Ward prospect is situated at an elevation of 7,950 feet, the main peak bearing S. 70° W. . . . The developments consist of three short tunnels. The vein, which is in rhyolite, strikes north and south, and the ore consists of a fine-grained, almost chalcedonic quartz, which probably replaces rhyolite. Bunches of stibnite needles and grains of pyrite replace this chalcedony or less silicified rhyolite. The ore is said to carry silver."

No attempt was made to study this mine area.

Finis claim. Stibnite occurs in an adit on the Finis claim one-fourth of a mile south of the Norman Bell claims. This adit is 900 feet long and has a crosscut and drift along a silicified rhyolite dike, which strikes N. 10° W. and dips 60° W. in a glassy rhyolitic flow, which strikes N. 80° W. and dips 15° S. The rhyolitic flow along the footwall of the dike is highly altered to a talcose material; the hanging wall shows alteration of the same type, but of less intensity. Minute crystals of stibnite are disseminated through the dike.

Norman Bell claims. Stibnite occurs in a small prospect pit on the Norman Bell claims, northwest of the Buckskin National mine. An 8- to 10-inch-wide shear zone, striking N. 10° W. and dipping 65° W., cuts rhyolite. Single crystals and small pods, up to 1 by 2 inches, of partially oxidized stibnite occur in a veinlet of quartz, opal, and chalcedony in the shear zone. Minute needles of stibnite are disseminated through the silicified rhyolite of the hanging wall. The dump contains several large boulders estimated to contain 60 percent antimony. The antimony content of five ore samples from these claims is shown below.

No.	Vein width (inches)	Sb %
1	2.0	0.45
2	2.0	0.47
3	0.3	9.18
4	3.0	0.85
5	3.5	0.66

NOTE: Samples taken from three trenches across vein.

Pine Forest Range

The Pine Forest Range is in the northwest part of Humboldt County, and is underlain by Jurassic-Triassic sediments, metasediments, schists, phyllites, and slates, intruded by a stock of

Tertiary granodiorite and diorite. Numerous small mines and prospects are scattered along its margin.

Juanita group

Other names	Pearl mine, Blue Rock group, Columbia mine, Black Rock group.
Location	Secs. 31 and 32, T. 42 N., R. 28 E.
Ownership	Josie Pearl, of Leonard Creek (1961).
Production	64 tons antimony (metal).
Base map	U. S. 1:250,000 scale topographic map, Vya sheet.

The Juanita group (fig. 18) in the Columbia (Varyville) mining district on the southwest side of Baxter Canyon on the southeast flank of the Pine Forest Range, comprises a number of pits, adits, shafts, and other underground workings, totaling several thousand feet.

Fine- to medium-grained diorite with considerable epidote and chlorite intrudes Jurassic(?) shale and limestone. A number of veins cutting the diorite are up to 60 inches wide, and consist of quartz, arsenopyrite, arsenic, iron oxides, and minor stibnite. High-grade stringers of gold reportedly occurred in the vein. Stibnite is scattered randomly through the veins and silicified diorite wall rock as small pods and single crystals.

Black Rock mine. The Black Rock mine is in the contact zone between the diorite and shale which strikes N. 40° E. and dips southeast. The fissure vein, 1 to 5 feet in width strikes N. 60° E. and dips 75° S.; it consists chiefly of brecciated and altered diorite, quartz, arsenopyrite, arsenic oxides, gold values, and a small amount of copper.

Blue Rock mine. The Blue Rock mine is north of the Black Rock mine (fig. 18) in highly argillized quartz diorite. The main vein strikes east-west and dips 30°–35° N., it is 4 to 6 inches wide and consists of gouge, some quartz and arsenopyrite, and minor stibnite. The latter occurs as small scattered grains and pods in quartz and diorite wall rock. The wall rock is stained by limonite.

Other mines. Other mines of the Juanita group are entirely in the diorite. The veins are similar to those at the Blue Rock and Black Rock mines. Arsenopyrite is abundant locally; it occurs in small pods, commonly enclosing smaller pods of stibnite. Stibnite also occurs separately as small pods and single crystals in the veins and diorite. Yellow antimony oxides are common in places. Antimony ore is present on several of the dumps.

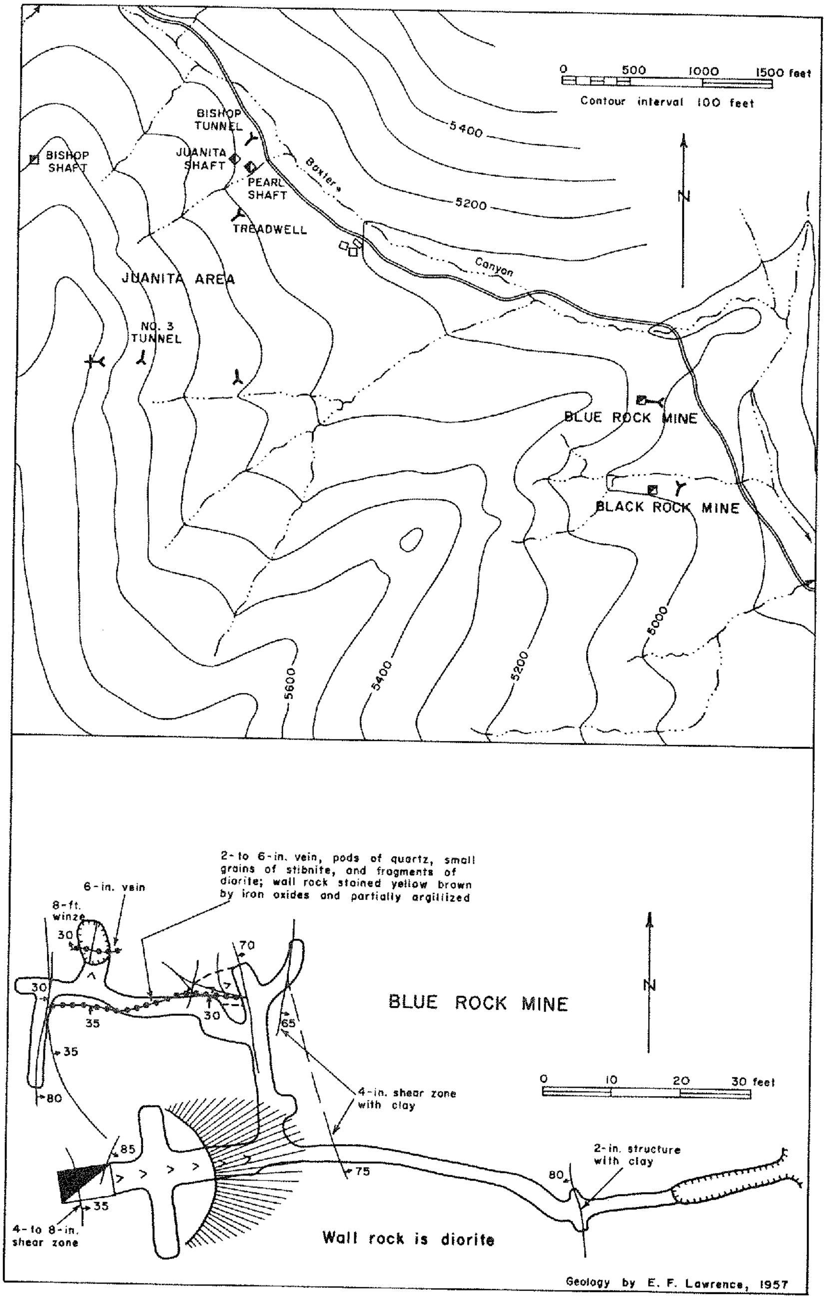

FIGURE 18. Index map of the Juanita Group (above) and geology of the Blue Rock mine, Humboldt County, Nevada.

The following table shows results of analyses of four ore samples taken from three mines of the Juanita group.

No.	Working	Description	Sb %	Au oz.	Ag oz.	Se %
130	Blue Rock	Grab sample, dump	None	None	None	None
131	Blue Rock	6-inch vein	None	0.24	0.24	....
132	Bishop Tunnel		0.48	0.20	0.35	....
133	Treadwell		None	None	None	....

Nevada King mine

Other names	American Antimony, Hill, Pass Canyon.
Location	Sec. 30, T. 44 N., R. 30 E.
Ownership	Harry E. Purdy (1957).
Production	22 tons antimony (metal).
Base map	U. S. 1:250,000 scale topographic map, Vya sheet.

The Nevada King mine (fig. 19) is in the Florence mining district on the east flank of the Pine Forest Range, at the head of Pass Creek Canyon, the first canyon south of Big Creek.

In 1927, 30 tons of ore containing 50 percent antimony were produced (White, unpublished data, U. S. Geol. Survey). In 1928 an ore shipment valued at $800 was made. In 1941, 1.5 tons of ore containing 41 percent antimony were produced; during 1942, two tons containing 54 percent antimony were produced. Later during 1942, five additional tons of ore were produced.

Mine development consists of four adits in the lower or south workings, and two shafts, an adit, and several open cuts in the upper or north workings. All workings are caved.

The Nevada King mine is near the contact of a series of Jurassic-Triassic schists, phyllites, and slates, and a stock of Tertiary granodiorite (Willden, 1961). A 200- to 300-foot-wide zone of skarn, tactite, and granulite margins the stock. All the workings are in the metamorphic rocks.

Of two shear zones present, one strikes N. 20° W. and dips 70°–80° W.; the other strikes N. 45° W. and dips 70° W. to vertical. Both zones are along bedding planes and are closely associated with cross faults in the schists and shales. The cross faults commonly strike N. 58° W. and dip 55°–75° SW. The wall rock is principally gray, micaceous schist and phyllite, and some black, micaceous slate.

Lenses, pods, veinlets, and single crystals of stibnite are found along the shear zones, commonly with quartz. Stibnite is disseminated through the wall rock within two inches of the shear zone. Black and white clay or gouge is locally abundant.

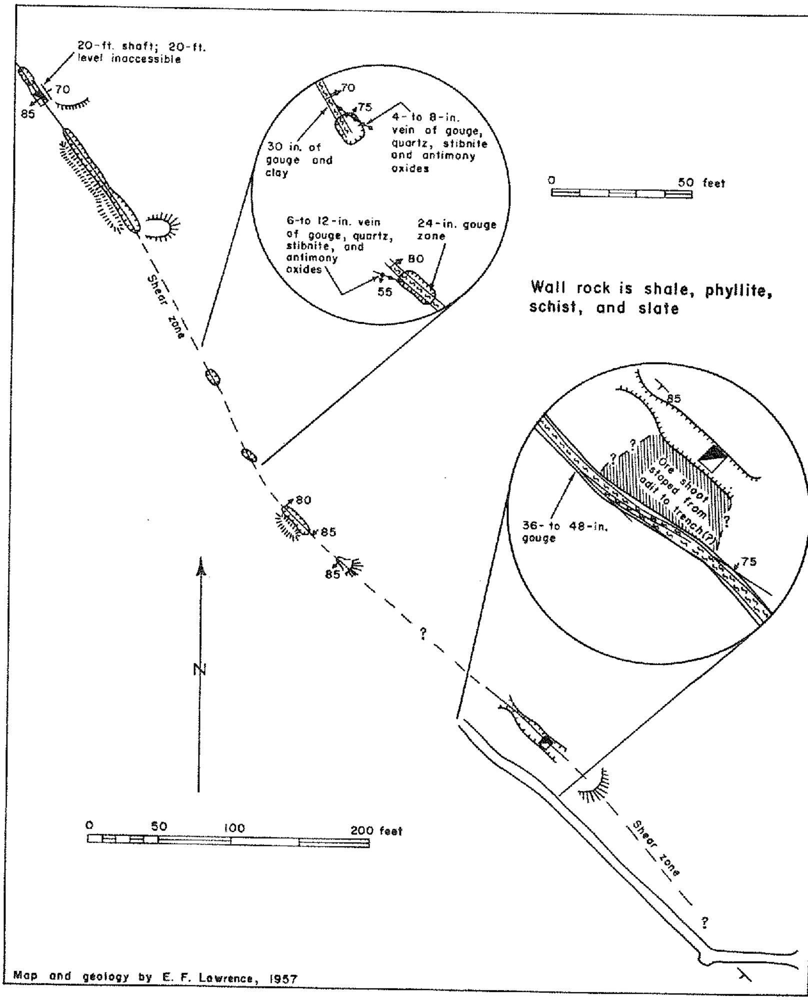

FIGURE 19. Geologic map of the Nevada King mine, Humboldt County, Nevada.

Much of the stibnite has been converted to yellow oxides and, less commonly, to white oxides. Both occur as resinous to earthy masses and powdery coatings along fractures. Locally thin-walled boxworks of quartz and yellow oxides have formed around grains of stibnite and limonitic boxworks also may be present. A few pseudomorphs of limonite after stibnite also were noted.

Analyses of four ore samples from the Nevada King mine are shown in the table below.

No.	Location	Description	Sb %	Au oz.	Ag oz.
125	Dump, lower adit	Grab sample	8.69	0.04	0.40
126	Upper adit	18-in. vein	Trace	0.02	0.46
127	Upper pit	5-in. vein	13.07	None	0.26
128	Dump, upper trench	Grab sample	1.76	None	None

Ore shoots occur at the intersection of the shear zones with crosscutting faults. Lateral movement along the faults apparently formed open areas in which the stibnite could be deposited. Away from the cross faults the shear zones apparently were relatively impervious so that little deposition took place.

Ten Mile Mining District

The Ten Mile mining district is located approximately 10 miles west of Winnemucca. The area is underlain by Triassic sediments which are overlain by Tertiary volcanics and intruded by numerous dikes of the same general age.

The Pansy-Lee mine contains antimony in the form of tetrahedrite, while the W. P. mine across the valley (see below) has stibnite as the principal antimony minerals.

Pansy-Lee mine

Other names	Case-Prout, West Coast.
Location	Secs. 1 and 12, T. 36 N., R. 36 E.
Production	Approximately 200 tons antimony (metal).
Base map	U. S. 1:250,000 scale topographic map, Vya sheet.

The Pansy-Lee mine is in the Krum Hills 11 miles northwest of Winnemucca. The mine has produced lead, zinc, and copper; and antimony as a by-product. The mine is developed by a 846-foot shaft inclined 67° E. with eight levels, on which there has been considerable development and stoping. The Nevada Consolidated mine, adjoining the Pansy-Lee mine on the south, is on the same vein. It is developed by several adits, open cuts, and a shaft 265 feet deep.

The vein strikes N. 20° E. to N. 5° W. in slate of the Raspberry Formation (Ferguson and others, 1951). It varies in thickness from a few inches up to several feet (averaging 17 inches), and consists mainly of quartz with lesser amounts of calcite, tetrahedrite, sphalerite, galena, pyrite, and arsenopyrite. The only antimony mineral is tetrahedrite with which sphalerite and galena are associated. Yellow antimony oxide occurs as coatings and powder-filling cavities originally occupied by tetrahedrite. Concentrates shipped in 1942 averaged 2 percent antimony, 0.6 ounce of gold, and 50 to 60 ounces of silver, in addition to lead, zinc, and copper. Antimony and other values found in ore samples from this mine are shown in the following table:

No.	Description	Sb %	Au oz.	Ag oz.	Pb %	Zn %
123	Vein, "Swede" level	2.05	0.34	12.80	....	....
124	Vein, 310-ft. level	0.57	0.18	32.80	1.5	3.8

W. P. mine

Other names............Crown Point.
Location............Secs. 1 and 2, T. 35 N., R. 36 E.
Ownership............J. W. Hicks (1957).
Production............39 tons antimony (metal).
Base map............USGS Rose Creek 15′ topographic quadrangle.

The W. P. mine is 7 miles west of Winnemucca on Table Mountain, half a mile south of State Highway 49, in the Ten Mile district.

During 1940–41, 49 tons of ore averaging 52 percent antimony were shipped. In late 1941, 51 tons of ore containing 10 percent antimony were shipped from the dumps; in 1942 13 tons of 50 percent antimony were produced. Mine openings include three adits, an inclined shaft and drifts, a raise, and three shallow winzes (fig. 20) totaling about 850 feet.

Upper Triassic quartzite and sandstone of the Winnemucca Formation crop out at the mine. The quartzite strikes N. 5° E., and dips 50° W. and is massive, fine- to medium-grained, gray to pink but weathers brown. Thin layers of gray to brown sandstone are interbedded with quartzite. The sandstone is composed of subangular to subrounded quartz grains and interstitial muscovite, biotite, and clay. Gray to black shale of the younger Upper Triassic Raspberry Formation is exposed in the lower plate of a thrust fault east of the workings. Tertiary basalt caps the hill to the west (Ferguson and other, 1951).

The thrust fault trends N. 20° E. and dips steeply west, and is

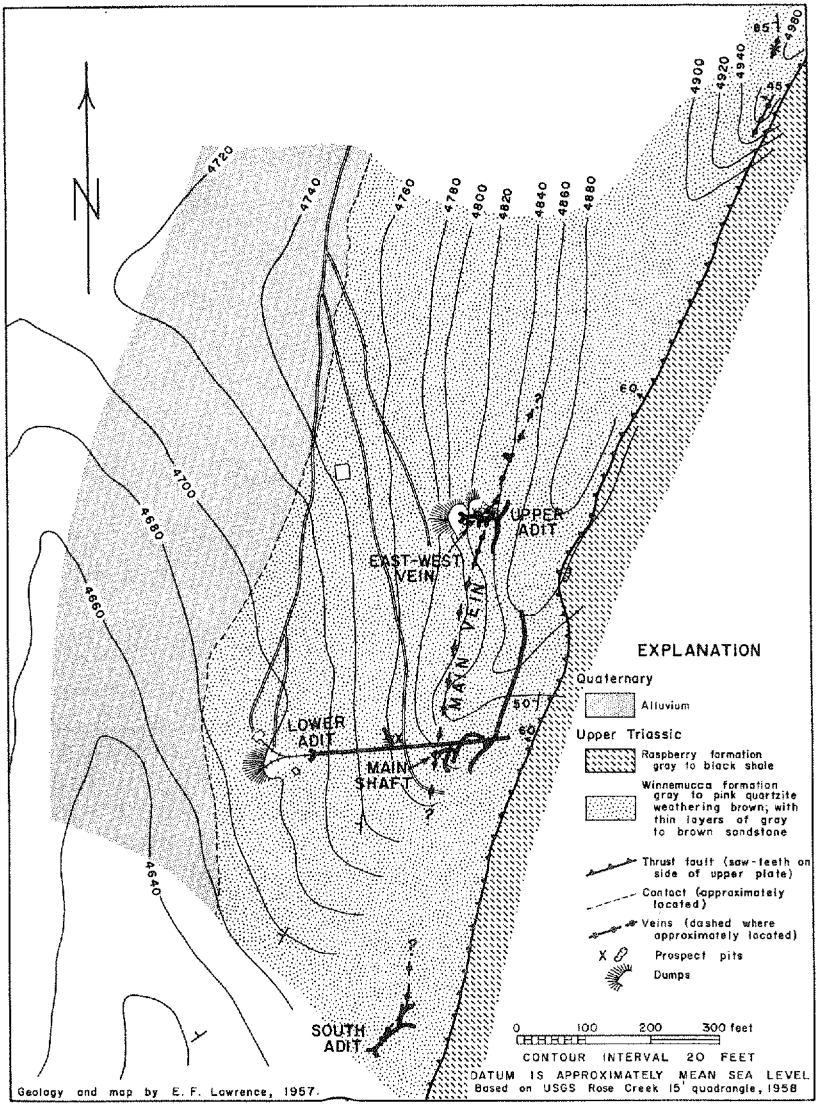

FIGURE 20. Geologic map of the W. P. mine and vicinity, Humboldt County, Nevada (see also plate 4).

exposed along the ridge east of the mine and in the lower adit 280 feet from the portal. It brings the Winnemucca and Raspberry Formations into contact.

The workings explore two vein systems in the quartzite and sandstone (pl. 4). The main vein strikes N. 10°–20° E. and dips 40°–85° E. It thickens upward from 4 inches to 48 inches, then splits into several veins separated by brecciated and slightly mineralized rock, forming a zone of good ore up to 96 inches in width. North of the shaft the main vein follows the quartzite-shale contact. The other vein, striking N. 70° E. and dipping 25° S., intersects the main vein. The east-west vein is up to 48 inches wide and contains numerous pods and streaks of ore. An ore shoot up to 48 inches wide at the intersection of the two veins rakes 35° S. Several faults offset both veins short distances.

The veins contain mostly quartz and brecciated quartzite. The quartz rarely fills the veins completely, and in places is brecciated and recemented by later quartz. However, there is no evidence that the quartz was deposited in several distinct stages. Although most of the quartz is cryptocrystalline, it occasionally occurs as small euhedral crystals in vugs.

Antimony occurs as stibnite, yellow and white oxides, and the oxysulfide kermesite. The stibnite is both crystalline and fine grained, and occurs as streaks and pods up to 24 by 36 feet in size, and less commonly as minute crystals enclosed in quartz crystals. All of the stibnite is at least partially altered. Kernels of the sulfide commonly are surrounded by diffusion halos of a red oxysulfide (kermesite?) which grade outward into yellow and white oxides. The yellow oxide probably is valentinite; it contains minute wisps of an isotropic mineral (stibiconite?). At one spot along the main vein in the lower adit numerous small pseudomorphs of reddish-brown iron oxide after pyrite were seen. Iron oxides also form diffusion halos around some of the pseudomorphs and have been deposited along fractures.

Minor argillization and silicification occur along the veins. Along the main vein the hanging wall is altered and the footwall generally unaltered.

The following table shows antimony, selenium, gold, and silver content of eight ore samples from the W. P. mine.

No.	Location	Description	Sb %	Au oz.	Ag oz.
2	Main shaft at 10 ft.	36-in. quartz vein	26.54	......	......
4	Main shaft, 17-ft. level	6-in quartz vein with stibnite and Sb oxides	20.43	Tr.	None
8	Main shaft, south drift 17-ft. level	12-in. quartz vein with stibnite and Sb oxides	9.36	Tr.	0.20
9	Top of inclined raise from lower adit	3-in. quartz vein with stibnite and Sb oxides	13.42	0.20	0.30
15	Upper adit, 38 feet from portal	20-in. quartz vein with stibnite and Sb oxides	13.16	0.02	0.50
17	Upper adit, middle winze at 5-ft.	6-in. quartz vein with stibnite and Sb oxides	16.84	......	......
21	Upper adit, bottom of eastern winze	36-in. quartz vein with stibnite and Sb oxides	10.57	0.16	0.24
23	Dump, upper adit	Grab sample	2.74	0.30	0.40

Other Occurrences in Humboldt County

Amos prospect

F. L. Hess (1916, private report) notes that: "Some stibnite is said to be found near Amos in the Santa Rosa Range." This occurrence would be in T. 41 N., R. 37 E., (see U. S. 1: 250,000 scale topographic map, McDermitt sheet).

Amos was an old stage station near the site of Cane Springs. A small amount of stibnite associated with quartz was reported on the dump of one of the mines at Cane Springs, but this occurrence could not be confirmed.

Getchell mine

Stibnite occurs sporadically in the Getchell mine associated with gold, realgar, orpiment, and ilsemannite. It is found in two areas in the south pit. Evidently this same occurrence was listed by Aune (unpublished data, U. S. Bureau of Mines) as the Potosi (Preble) occurrence, in sec. 33, T. 39 N., R. 42 E. (see USGS Osgood Mts. 15′ topographic quadrangle).

Joralemon (1951, p. 273) stated:

> "Stibnite, like orpiment, occurs in restricted pockets in which it is present in two unusual forms. Stibnite occurring in narrow, pipe-like bodies is present in a series of clusters of hair-like crystals so minute as to suggest a soft black velvet coating on the rocks. The molybdenum mineral ilsemannite is closely associated with this stibnite. In one small area the fractures in the rock are coated with metastibnite,

a red paint or stain which has been shown by X-ray photographs to be finely dispersed stibnite. Similar forms of stibnite have been found in the sinter and the hot-spring muds at Steamboat, Nevada."

Joralemon suggested that the stibnite was probably deposited at the same time as the orpiment, realgar, marcasite, magnetite, gold, and silver.

Snowdrift mine

Other names	Antimony group, Donnisher's Spring, Knight & Morris, Bonita Spring, Juniper Hills, Rosebud district (?).
Location	Sec. 1 (?), T. 37 N., R. 30 E.
Production	0.6 ton antimony (metal).
Base map	U. S. 1:250,000 scale topographic map, Vya sheet.

The Snowdrift mine (fig. 21) is in the Red Butte mining district on a hill in a low divide in the Jackson Mountains, 1⅓ miles southeast of the Red Butte mine. The last known owner was McKinley W. Butts, of Winnemucca.

Shortly before World War I, the mine produced a small amount of ore. In 1923, approximately two tons of ore containing 30 percent antimony were mined. Two grab samples assayed 50.6 percent antimony, 0.11 percent arsenic, traces of lead and copper; and 40.1 percent antimony, 0.32 percent arsenic, 0.08 percent lead, and 0.06 percent copper. Mine openings include several trenches, a short adit, two short inclined shafts, and some stopes.

The mine is on the contact between an intrusive body of diorite and andesite tuffs and flows. A quartz vein, striking N. 5°–30° W. and dipping 20°–30° E., occurs along a brecciated zone in these rocks. The vein is 6 to 28 inches in width and consists mainly of angular fragments of wall rock cemented by quartz. The fragments are partially silicified. Although no stibnite was seen in the mine, veinlets and pods up to 4 inches across were found in pieces of quartz on the dump. White, yellow, gray, and brown antimony oxides occur as stains on quartz, as resinous to earthy masses, and as pseudomorphs after needles of stibnite. Arsenopyrite is common. Pyrite occurs sporadically in the vein. Chloropal is common as large and small masses which commonly contain traces of antimony and arsenic oxides. Limonite stains the wall rock, and is present as pseudomorphs after pyrite. A grab sample of the quartz vein at the bottom of the southern inclined shaft assayed 0.26 percent antimony, 0.40 ounce of silver, and no gold.

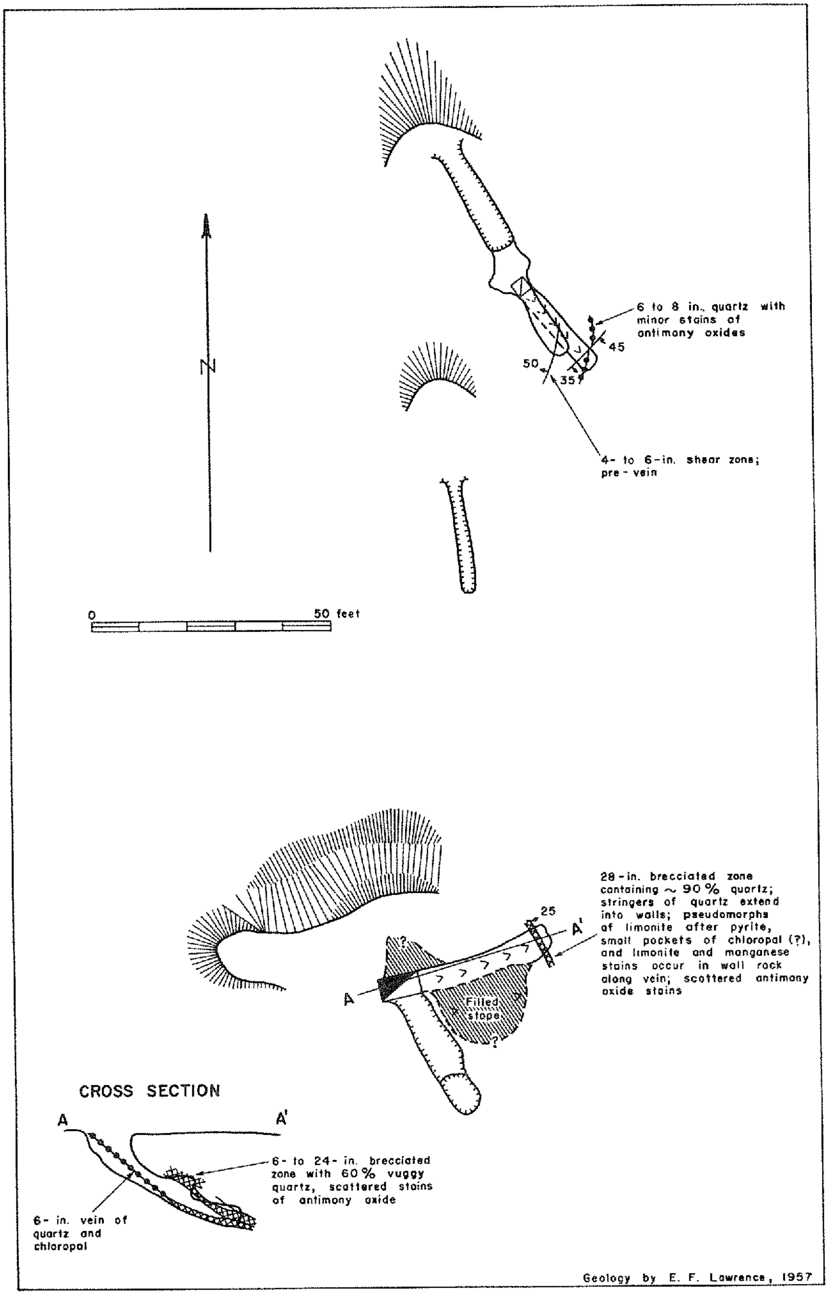

FIGURE 21. Geologic map of the Snowdrift mine, Humboldt County, Nevada.

LANDER COUNTY

Battle Mountain Mining District

The Battle Mountain district, in the Battle Mountain Range, approximately 12 miles southwest of Battle Mountain, Nevada, has produced $4,825,080 in copper, silver, gold, lead, and antimony (Couch and Carpenter, 1943, p. 73). Copper has been mined in the Copper Canyon and Copper Basin areas; chalcocite, chalcopyrite, bornite, cuprite, malachite, chalcanthite, chrysocolla, azurite, and native copper are the principal minerals. Gold has been mined in nearly every canyon in the district, with one large placer deposit at the mouth of Copper Canyon. Silver was mined at Galena and Buckingham Camp. Galena and sphalerite have been found at Galena, Buckingham Camp, and Copper Canyon. Antimony has been mined at the Mizpah, Cottonwood Canyon, and the Apex mines. A crude regional zoning of metal values is suggested as a possible guide in future exploration work in the area.

The area is underlain by Paleozoic sediments of both the eastern and western assemblages, ranging in age from Ordovician through Permian. These are overlain by Tertiary rhyolite, pyroclastics, and basalt. Granodiorite and quart-monzonite are intrusive into the Paleozoic sediments as stocks, dikes, and sills. Thrusting during the Antler orogeny and during Permian and Mesozoic time has complicated the structure (Roberts, 1951).

Apex mine

Other names	Pesi.
Location	Sec. 11, T. 31 N., R. 43 E.
Ownership	Lili Pesi, of Loomis, California.
Production	25 tons antimony (metal).
Base map	USGS Antler Peak 15′ topographic quadrangle.

The Apex mine is on a ridgetop 0.4 of a mile up Cow Canyon from Galena Canyon and about 1,000 feet east of the road, just above the Pesi Ranch.

Shipments of antimony ore were reported in 1870. The mine includes an open cut, two short adits, a 124-foot shaft from which 215 feet of drifting has been done on four levels (the 48-, 61-, 83-, and 120-foot levels).

The Mississippian Scott Canyon and Harmony Formations at the mine are separated by a thrust fault (Roberts, 1951). A vein striking N. 45°–70° E. and dipping 70°–80° NW., cuts thin-bedded quartzite (fig. 22). Stibnite occurs in the vein as small

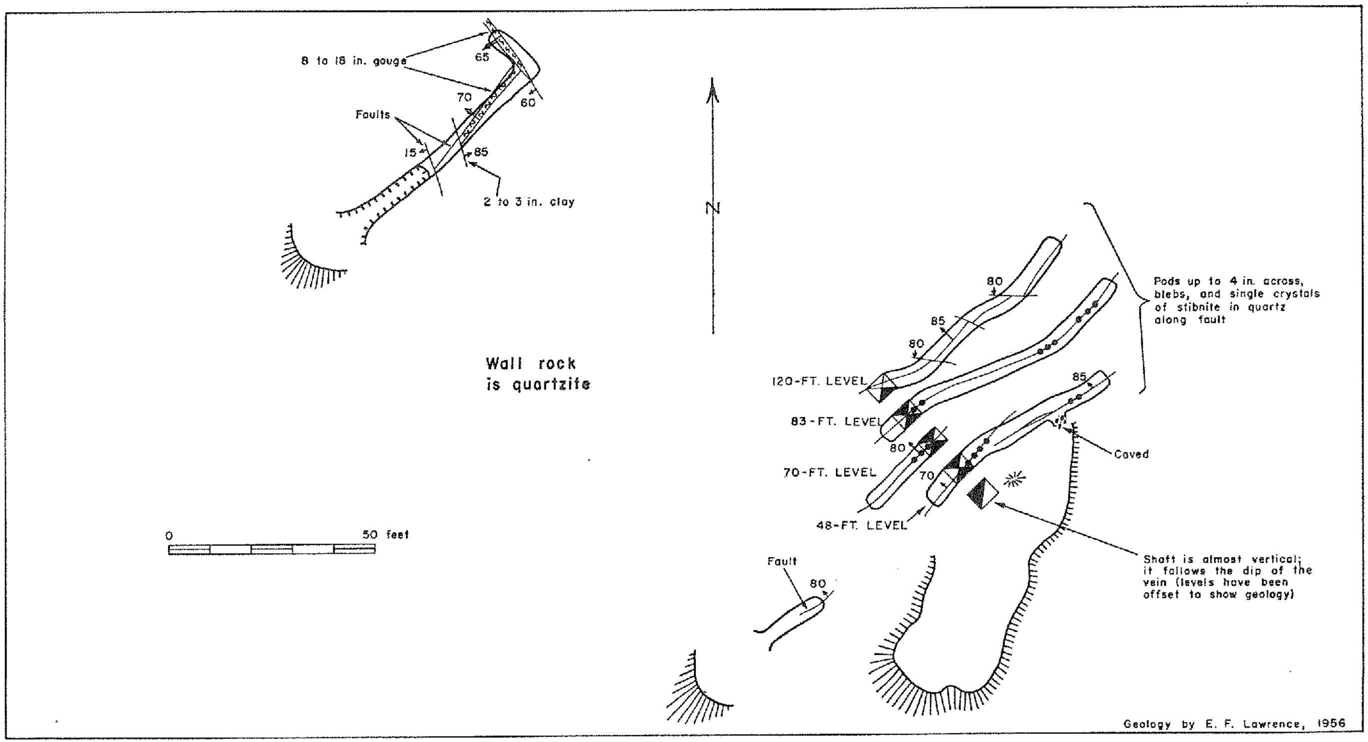

FIGURE 22. Geologic map of the Apex mine, Lander County, Nevada.

elongate pods, veinlets, and single crystals. The vein averages 2 to 4 inches in thickness, but locally widens to 24 inches. One ore shoot, now mined out, extended from the 48-foot level to the 83-foot level, was 15 feet long, 60 feet high, up to 24 inches thick, and raked 60° NE.; it consisted of pods of stibnite up to 4 by 36 inches. A second ore shoot in the bottom of the shaft yielded 8 tons of high-grade ore. Antimony, gold, and silver assays from two ore samples from this mine are shown in the table below. Stibnite commonly is partially altered to fibrous white and resinous to powdery yellow antimony oxides. Kermesite is common.

No.	Location	Description	Sb %	Au oz.	Ag oz.
148	90-ft. level	2-in. vein	5.39	Tr.	0.50
149	Adit	18-in. vein	0.60	0.04	0.24

Cottonwood Canyon mine

Other names	Antimony King, Mitchell, Star.
Location	Sec. 35, T. 32 N., R. 43 E. and sec. 2, T. 31 N., R. 43 E.
Ownership	Mrs. Rose Mitchell, of Battle Mountain, Nevada.
Production	156 tons antimony (metal).
Base map	USGS Antler Peak 15′ topographic quadrangle.

The Cottonwood Canyon mine is in Little Cottonwood Canyon, 2.7 miles from the canyon mouth, on the east flank of Antler Peak.

According to reports, several hundred tons of ore had been mined before 1883. Although some of this was concentrated in a small mill at Battle Mountain and shipped to San Francisco and New York, much of it was left on the dump. An assay returned 62.28 percent antimony and 6.63 percent bismuth, (Williams, 1883, p. 438).

The following summarizes the known production of the mine: 150 tons of high-grade antimony oxide produced in 1884 under the direction of George Star, oxide shipped to New York; ore valued at $1,500 produced in 1906 (J. M. Pine, private report, 1907); 14.3 tons of ore containing 43 percent antimony produced in 1917; 12.9 tons of ore containing 62.5 percent antimony produced in 1918; 44 tons of ore containing 24 percent antimony produced in 1939; 70 tons of ore containing 34 percent antimony produced in 1941; a carload of ore produced in 1942; ore valued at $800 produced in 1946 and shipped to Toulon, Nevada.

Most of the early production apparently came from the southern workings while the later production came from the northern workings.

The property comprises the Antimony King, Antimony King No. 1, Antimony King No. 2, Old Gold Fraction, Last Chance, and Last Chance Nos. 1, 2, 3, 4 claims. The deposit is developed by two 100-foot shafts, a 50-foot shaft, three adits totaling 200 feet, several other short adits, stopes, and a number of prospect pits (pl. 5). One of the shafts is caved.

At the mine, argillite, shale, grit, quartzite, and chert of the Mississippian Scott Canyon Formation strike N. 15° E. and dip 30°–40° W. (Roberts, 1951). These rocks are in the bottom plate of the DeWitt thrust fault. The upper plate includes rocks of the Harmony Formation. North-trending normal faults are common in the area; two of them bound the mining block.

A gray quartz-porphyry dike, striking N. 15° E. and dipping 80° E., cuts the Scott Canyon Formation. The dike is about 12 to 20 feet wide, and consists of large phenocrysts of quartz and feldspar in an aphanitic groundmass of quartz, feldspar, hornblende, and biotite. East-trending normal faults showing left lateral movement offset the dike up to 40 feet; the same faults displace north-trending faults and the veins.

The main vein strikes N. 15°–30° E. and dips 45°–80° W. Several smaller veins and barren faults split from it. All are in the north- to northeast-trending system of normal faults with a total displacement of several hundred feet. In the northern workings the deposition seems to have been localized near the intersection of the splits and main vein. The veins are up to 48 inches wide, and consist principally of quartz and gouge with some chalcedony, opal, calcite, stibnite, and pyrite. Stibnite occurs as single crystals, blebs, pods up to 12 inches across, and veinlets in the quartz and gouge. Pyrite occurs as minute cubes, closely associated with, but not intimately mixed with, the stibnite.

Stibnite also occurs in fractures in the dike as pods, blebs, and single crystals in and with quartz, and as needle-like inclusions in the stubby quartz crystals that line the numerous vugs in the dike. Stibnite commonly is partially to completely oxidized. The red oxysulfide kermesite occurs as rims around blebs of stibnite and as inclusions in the quartz crystals lining the vugs in the dike. White antimony oxide is common as pseudomorphs after bladed stibnite and as cellular boxworks. Earthy to vitreous yellow oxide surrounds the white oxide.

The dike and the country rock along the veins are argillized, sericitized, and silicified. The phenocrysts in the dike commonly are more highly altered (sericitized) than the groundmass.

The stibnite was deposited after the intrusion of the dike. The quartz apparently was deposited both simultaneously with and later than the stibnite. The following table shows analyses of four ore samples from this mine:

No.	Description	Sb %	Au oz.	Ag oz.	Se %
136	10-in. vein, northern area east adit	1.79	Tr.	0.30	Tr.
137	12-in. vein, stope	48.50	0.04	0.92	......
138	8-in. vein, adit, southern area	8.63	0.24	0.22	......
139	Grab sample, 1 ton stockpile, dump, northern area	12.60	Tr.	1.86	......

Mizpah mine

Other names .... Burridge, Irish Rose, Buckingham.
Location .... Sec. 36, T. 32 N., R. 43 E.
Ownership .... Gertrude Burridge, of Battle Mountain (1958).
Production .... Less than 1 ton antimony (metal).
Base map .... USGS Antler Peak 15′ topographic quadrangle.

The Mizpah mine is 3 miles northwest of Antler Peak and approximately 1,500 feet southeast of the Irish Rose mine.

In 1920, the mine began shipping 12 to 14 percent arsenic ore to the Toulon Arsenic Co., at Toulon, Nevada (Lincoln, 1923, p. 107). In 1941, antimony ore was discovered on the ridge south of the mine and of the 60 tons mined, 800 pounds of material assaying 46.8 percent antimony were cobbed.

A vein which strikes N. 45° E. and dips 75° SE., cuts quartzite and sandstone of the Mississippian Harmony Formation. The vein is 4 to 8 inches wide, and contains small pods, blebs, veinlets, and single crystals of stibnite. A small amount of the stibnite is altered to vitreous to resinous, yellow antimony oxides, and to fibrous, white antimony oxide. Some of the yellow oxide is pseudomorphic after stibnite. Only a trace of stibnite remains in the pit; a grab sample assayed 0.8 percent antimony, 0.04 ounce of gold, and 8.80 ounces of silver per ton. The wall rock is partially argillized and sericitized for a few inches out from the vein.

Weber mine

Other names	"65" Claims, White Lily, Lonesome Pine, Colorado, Antimony, Mendive(?).
Location	Sec. 10, T. 31 N., R. 43 E.
Ownership	A. R. Hides, of Battle Mountain (1956).
Production	None.
Base map	USGS Antler Peak 15′ topographic quadrangle.

The Weber mine is at the head of Scott Canyon, 1 mile north of Galena Creek, and approximately 13 miles south of Battle Mountain.

A. R. Hides (oral communication, 1957) stated that 128 tons of ore contained 9 to 14 percent lead, 0.30 ounce of gold and 40 to 70 ounces of silver per ton, but no antimony. Probably antimony was present, but was not recovered or assayed. The mine is developed by two 25-foot and one 10-foot adits.

The Mississippian Scott Canyon Formation (Roberts, 1951) crops out at the mine. Two veins, striking N. 25°–35° E. and dipping 55°–65° NW., vary in width from 12 to 36 inches, and contain abundant gouge and minor quartz. A few small pods of ore occur sporadically in the gouge. A small stockpile of ore at one of the adits contains galena, sphalerite, pyrite, chalcopyrite, arsenopyrite, and a small amount of stibnite. A grab sample assayed 1.0 percent antimony, a trace of selenium, and 0.08 ounce of gold and 5.36 ounces of silver per ton.

Northern Shoshone Range

The Hilltop and the Lewis mining districts are located in the northern Shoshone Range, approximately 19 miles southeast of Battle Mountain. The Hilltop district has produced $424,669 in gold, silver, copper, and lead; and the Lewis district $3,188,805 in gold and silver (Couch and Carpenter, 1943, p. 74). There appears to be a rough zoning around these districts of antimony, gold, silver, lead, and copper.

The area is underlain by many thousands of feet of Ordovician, Silurian, and Devonian quartzite and chert of the Paleozoic western assemblage which have been thrust over a Cambrian- to Devonian-Age carbonate sequence of the eastern assemblage. Windows of these carbonate rocks are visible in the Goat Ridge area, a few miles south of Hilltop, and the thrust may be seen east of Hilltop (Roberts and others, 1958, p. 2813–2857). Mesozoic(?) thrusting has further complicated the structure of the area (Gilluly, 1960).

Betty O'Neal mine

The Betty O'Neal mine is at the mouth of Lewis Canyon on the west slope of the Shoshone Range, in sec. 22, T. 30 N., R. 45 E. (see USGS Mt. Lewis 15′ topographic quadrangle), 13 miles southeast of Battle Mountain.

Over 8 million dollars of silver and gold ores have been produced. In 1958, the property was owned by the Battle Mountain Bank and Mortgage Co.

Quartzite with intercalated black, shaly, siliceous beds, and some limestone and slate, crop out at the mine. Two veins, the Betty O'Neal and Estella, generally strike north and dip 45° W.; they range from 2 to 55 feet in width and consist of quartz, calcite, tetrahedrite, stephanite, argentite, polybasite, galena, pyrite, and sphalerite. Cerargyrite, associated with malachite and azurite, is common near the surface (Vanderburg, 1939, p. 63). In 1927 Paul Grai reported (written communication) considerable stibnite in one area of the mine, but recent operators have failed to find it.

Blue Dick mine

Other names	Kirk, Harmon (?).
Location	Sec. 6, T. 29 N., R. 46 E.
Production	Over 60 tons antimony (metal).
Base map	USGS Mt. Lewis 15′ topographic quadrangle.

The Blue Dick mine is in Crum Canyon along the west fork of Rock Creek on the east flank of Mt. Lewis in the Hilltop mining district of the Shoshone Range.

In 1917 and 1918, 18 carloads of antimonial silver ore with a gross value of $20,000 were reportedly mined. In 1934, 2,492 tons of (antimonial silver?) ore having a gross value of $74,093 were shipped. The values in the shipments apparently were mostly in silver, and although the ore probably contained antimony it is not known whether or not it was recovered.

Antimony ore reportedly was mined from two claims along the west fork of Rock Creek at the south end of the Blue Dick mine area. During World War I, approximately 100 tons of sorted ore containing 60 percent antimony were mined from these claims (Vanderburg, 1939, p. 53). In 1941, the claims produced 12 tons of antimony ore, which were shipped to the Metal Reserve Board stockpile at Battle Mountain.

The property is developed by seven scattered adits, five of which are caved and two of which are only partly accessible. The longest is about 250 feet; the others aggregate 2,000 feet. The deepest working is only 150 feet below the surface.

Pale-blue Ordovician (?) quartzite and thin interbedded chert, striking N. 70° W. and dipping 35° S., are overlain by 20 feet of conglomerate and 5 feet of sandstone, with lenses of impure coal which are overlain by rhyolite agglomerate.

The Blue Dick No. 1 adit, on the south side of the west fork of Rock Creek in the SE¼ sec. 6, explores a narrow quartz vein striking N 5° E. and dipping 70° W. The vein is closely associated with a 6-inch coal seam. Blebs, single crystals, pods, and veinlets of stibnite occur in the vein. Although stibnite is present as crystals in vugs, it more commonly is finely granular or bladed and enclosed by quartz. A grab sample of ore assayed 57.77 percent antimony, 0.04 percent selenium, 0.02 ounce of gold and 29.94 ounces of silver per ton.

The Blue Dick No. 2 adit is 180 feet northeast of the No. 1 adit, and a few feet from the creek. Here, a second vein striking N. 40° W. and dipping 60° W., cuts pale-blue quartzite and is exposed on the hillside above by a caved adit and an open cut. The vein material consists of quartz and a few blebs of stibnite.

Stibnite in both veins has been slightly oxidized to yellow and white antimony oxides. The yellow oxide is resinous to powdery, and occurs as both residual and transported material. The white oxide is fibrous and commonly replaces bladed stibnite.

Blue Nose mine

Other names	Borredo, Borrego, Harmon, Sizemone.
Location	Sec. 31, T. 30 N., R. 46 E.
Production	None.
Base map	USGS Mt. Lewis 15′ topographic quadrangle.

The Blue Nose mine is in the Lewis mining district on the saddle between Lewis and Crum Canyons, half a mile north of the Dean mine and 2 miles north of Mt. Lewis.

In 1940, six tons of ore averaging 25 percent antimony were produced. The mine is developed by a 35-foot inclined (65°) shaft and a 155-foot adit with a 50-foot drift 105 feet from the portal.

Quartzite, limestone, and shale of the Ordovician Valmy (?) Formation crop out at the mine (fig. 23). Several gray quartz porphyry dikes cut the sedimentary rocks. The dikes consist of 10 to 20 percent quartz, orthoclase, plagioclase, and minor biotite and hornblende phenocrysts in a fine-grained groundmass of

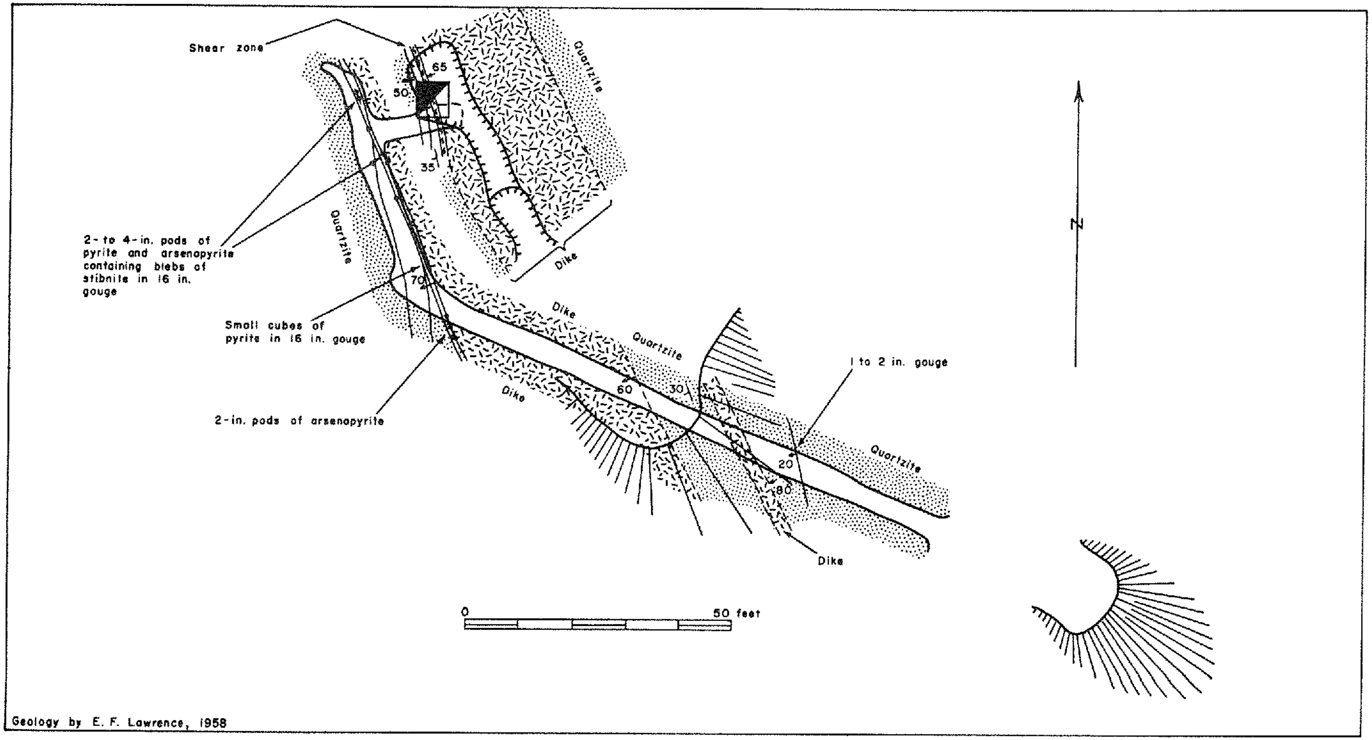

FIGURE 23. Geologic map of the Blue Nose mine, Lander County, Nevada.

orthoclase and quartz. At the mine, the dikes are argillized and sericitized and contain numerous small psuedomorphs of limonite after pyrite.

At the shaft a shear zone parallels the hanging wall of a dike 17 feet in width. A vein 12 to 60 inches wide, striking N. 20° W. and dipping 65°–70° W., occurs in the shear zone. A small amount of stibnite with associated arsenopyrite and pyrite is present as pods and blebs. The stibnite is partially altered to yellow antimony oxide. The following table shows analyses of three ore samples from this mine:

No.	Description	Sb %	Au oz.	Ag oz.
189	Grab sample, dump	1.0	None	9.38
190	Grab sample, dump	0.8	0.04	45.64
191	Grab sample, dump	1.1	Tr.	129.76

Harmon prospect

Schrader (unpublished data, U. S. Geol. Survey) stated:

> "The Harmon prospect, owned by Floyd Harmon, is said to be 16 miles south of Battle Mountain, in the Hilltop Range adjacent to the Dean-Pillsbury (sic) property. The property is said to consist of a quartz-stibnite vein on a limestone-andesite contact. The vein is said to be from half a foot to 2 feet in width and have a known extent of 500 feet. The property was said to be about ready to ship its first carload of 50 percent ore October, 1915."

This property probably is the same as the Kirk mine described by Vanderburg (1939, p. 53), but may be the same as the Blue Dick mine described elsewhere in this report.

Kattenhorn mine

The Kattenhorn mine is in the Hilltop mining district, on the west side of Crum Canyon, half a mile east of the Blue Dick mine, in secs. 5 and 6, T. 29 N., R. 46 E., and sec. 32, T. 30 N., R. 46 E. (USGS Mt. Lewis 15′ topographic quadrangle).

Two hundred thousand dollars worth of ore (probably lead-silver-antimony) was produced from this mine during the 1880's. The present owners are Mrs. Pearl Kattenhorn and son, Louis Kattenhorn, of Battle Mountain, Nevada. The mine is developed by six adits and other workings totaling several thousand feet in gray to blue quartzite that generally strikes N. 70° W. and dips E. 35° S. Three veins have been explored. The main vein strikes N. 45° W. and dips 55° SW., (fig. 24). The shear zone is offset by two cross faults.

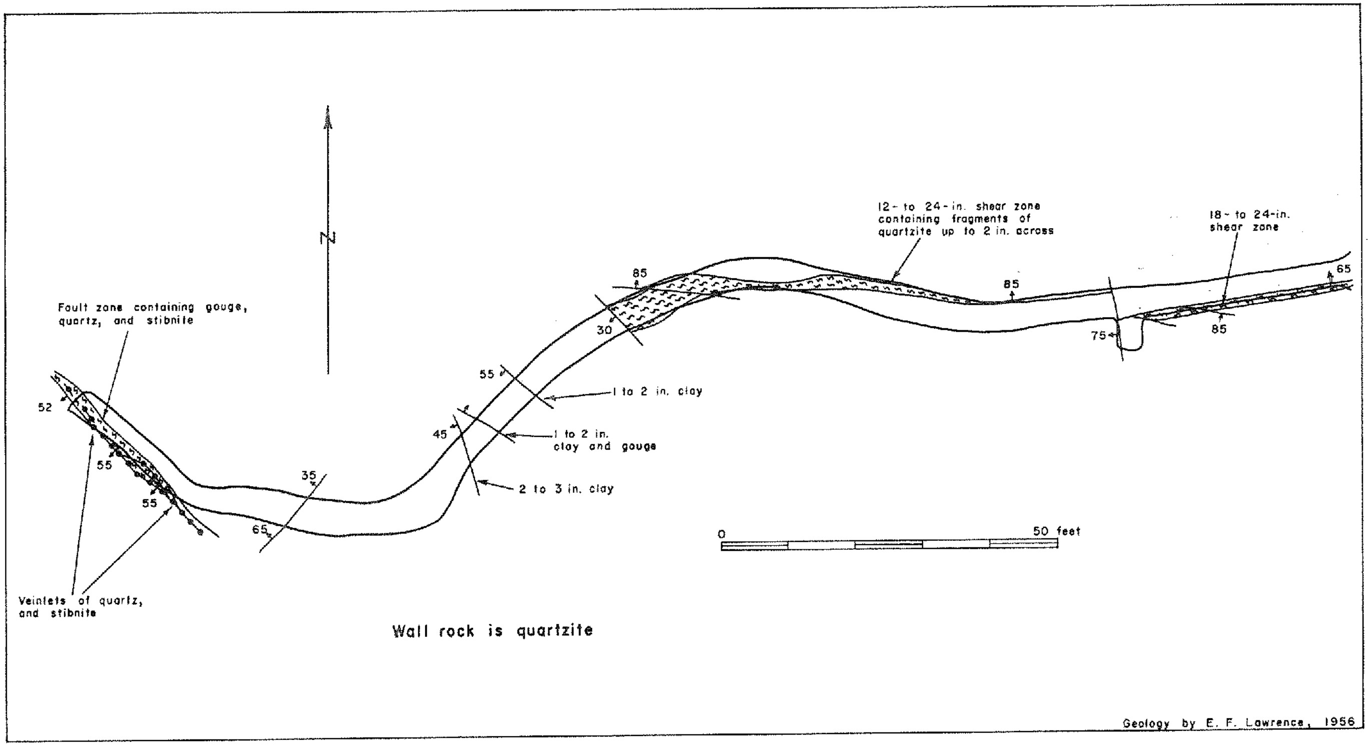

FIGURE 24. Part of lower adit of the Kattenhorn mine, Lander County, Nevada.

It is 6 to 30 inches wide and consists principally of gouge and minor quartz. Stibnite occurs as veins 2 to 4 inches wide, as pods up to 3 by 12 inches, and as small single crystals and rosettes scattered randomly throughout the quartz. Some of the stibnite crystals are curved and are up to one-fourth of an inch long. Some small blebs and cubes of pyrite occur along fractures associated with stibnite. Both pyrite and arsenopyrite are common in the Old Kattenhorn mine to the northwest, farther up the canyon.

The stibnite is slightly altered to yellow, and less commonly, to greenish-yellow antimony oxides. In the lower adit a few orange-red halos of oxysulfide occur around some blebs of stibnite. The quartzite along the vein is leached and argillized. Locally it is brecciated and recemented by quartz.

Analyses of five ore samples from this mine are given in the following table:

No.	Description	Au oz.	Ag oz.	Sb %	Se %	Pb %	Cu %
141	6-in. vein	0.06	1.30	2.58	......	......	......
142	1-in. vein	0.02	3.60	22.23	......	......	......
143	2-in. by 24-in. pod stibnite at face	0.04	139.12	15.92	0.10	......	......
144	4-in. vein with gouge	0.02	70.52	20.65	0.13	None	None
186	16-in. vein	0.06	9.38	0.6	Tr.	None	......

Big Creek Mining District

The Big Creek mining district is on the western flank of the Toiyabe Range, 12 miles south of Austin.

Early Paleozoic shale, siltstone, slate, chert, and limestone crop out in the district. In the central part, Silurian (?) shale, siltstone, and slate are overlain by gray crystalline cherty Mississippian (?) limestone. A few glassy (rhyolitic?) dikes are exposed along the crest of the ridge, but no dikes were observed in the vicinity of the mines. Granodiorite intrudes the central core of the range, but like the dikes, is not exposed in the mine area. Rhyolite caps shale and limestone over a small area at the mouth of Big Creek.

A north-trending anticline marks the crest of the range, and a fractured zone with some associated silicification follows the axis of this anticline.

Antimony King mine

Other names	Pine, Dry Canyon, Big Creek, Stokes, Mammoth, Mt. View, Commodore, Confidence.
Location	Secs. 25, 26, and 36, T. 18 N., R. 43 E.
Ownership	Big Creek Mining and Milling Co. (1958).
Production	More than 489 tons antimony (metal).
Base map	USGS Austin 15′ topographic quadrangle.

The Antimony King mine is on the crest of the Toiyabe Range at the head of Dry Canyon, 2.8 miles from the mouth of the canyon.

Early production from this mine included 40 tons of ore valued at $3,500, shipped in 1907; 25 tons of 60 percent ore in 1911; and 25 tons of ore valued at $1,610, sold in 1915. By 1922, a total of approximately 400 tons of ore had been shipped, most of it to the Nichols-Layng Chemical Co. of San Francisco (Schrader, unpublished data, U. S. Geol. Survey). Phil W. Cox leased the mine from J. G. Phelps Stokes in 1948 and subsequently shipped 30 tons of antimony ore.

The mine was owned by the Big Creek Mining and Milling Co., which produced 1,120 tons of ore in 1957. Although the assay content of this ore was computed at 89,720 pounds of antimony, only 57,705 pounds were recovered in the milling operations. In 1958, 25 tons of concentrates assaying 66.48 percent antimony (valued at $3,740) were sold to the South American Minerals and Merchandise Co., in New York, for shipment to Belgium (E. W. Thompson, oral communication, 1958).

The property consists of the Mammoth, Mountain View, Confidence, and Commodore patented claims and a patented mill site. It is developed by a 75-foot adit, open pits, a 230-foot inclined shaft, a 440-foot adit connecting with the bottom of the inclined shaft, and several levels from the shaft, as shown in plate 6.

Shale, siltstone, sandstone, chert, and limestone crop out at the mine. East of the ridge, these rocks strike N. 45° W. and dip to the east; west of the ridge they strike N. 35° W. and dip to the west.

The main mineralized zone strikes N. 55° W. and dips 55° SW. and extends for over 500 feet northwest of the shaft. The zone appears to be made up of silicified fault breccia recemented by quartz and calcite veinlets. It forms a prominent outcrop along which considerable surface mining has been done. Numerous cross fractures, generally striking N. 45° E. cut the zone. One fault on the 40-foot level strikes north and dips 55°–60° E., and apparently was an important factor in localizing the ore. Several northeast-trending faults cut and offset the veins. The main vein is 2 to 9 feet wide.

Stibnite occurs as single crystals, blebs, veinlets, and occasional pods up to 20 inches across in quartz and silicified limestone. The small pods and blebs of bladed and fine granular stibnite are rather evenly distributed through the fault zone. Some blades are 2 inches long, but more commonly are half an inch in length. Minute pyrite cubes are associated with stibnite and are scattered sparsely through the veins. Forty tons of ore came from a shoot in a silicified zone on the 230-foot level. White, yellow, and gray antimony oxides are less abundant than stibnite. The white oxide is fibrous or cellular. The powdery to resinous yellow oxide occurs as coatings along fractures and pseudomorphs after individual needles and rosettes of stibnite. Red oxysulfide (kermesite?) coats and fills cracks in stibnite. Pyrite commonly is oxidized to limonite. The following table shows the antimony content of 11 ore samples from the Antimony King mine.

No.	Description	Sb %	Au oz.	Ag oz.	Se %
184	Grab sample, ore bin at mouth of canyon	4.79	0.10	0.10	Tr.
1	Open cut 240 feet north of shaft	6.4	......	......	......
2	Open cut 240 feet north of shaft	7.3	......	......	......
3	Grab sample, main dump	8.5	......	......	......
4	10 sacks sorted shipping grade ore	60.8	......	......	......
5	75-foot level, south face, 73-inch vein	6.3	......	......	......
6	75-foot level, 78-inch vein	5.5	......	......	......
7	75-foot level, 78-inch vein	8.5	......	......	......
8	75-foot level, 72-inch vein	11.1	......	......	......
9	75-foot level, 84-inch vein	12.6	......	......	......
10	75-foot level, 96-inch vein	9.2	......	......	......

Bray-Beulah mine

Other names .... Beulah, Genesee.
Location .... Secs. 27, 34, and 35, T. 17 N., R. 43 E.
Ownership .... Beulah claim: Mary J. Bray.
Genesee claim: James O. Holmes.
Production .... Over 1,000 tons antimony (metal).
Base map .... USGS Austin 15′ topographic quadrangle.

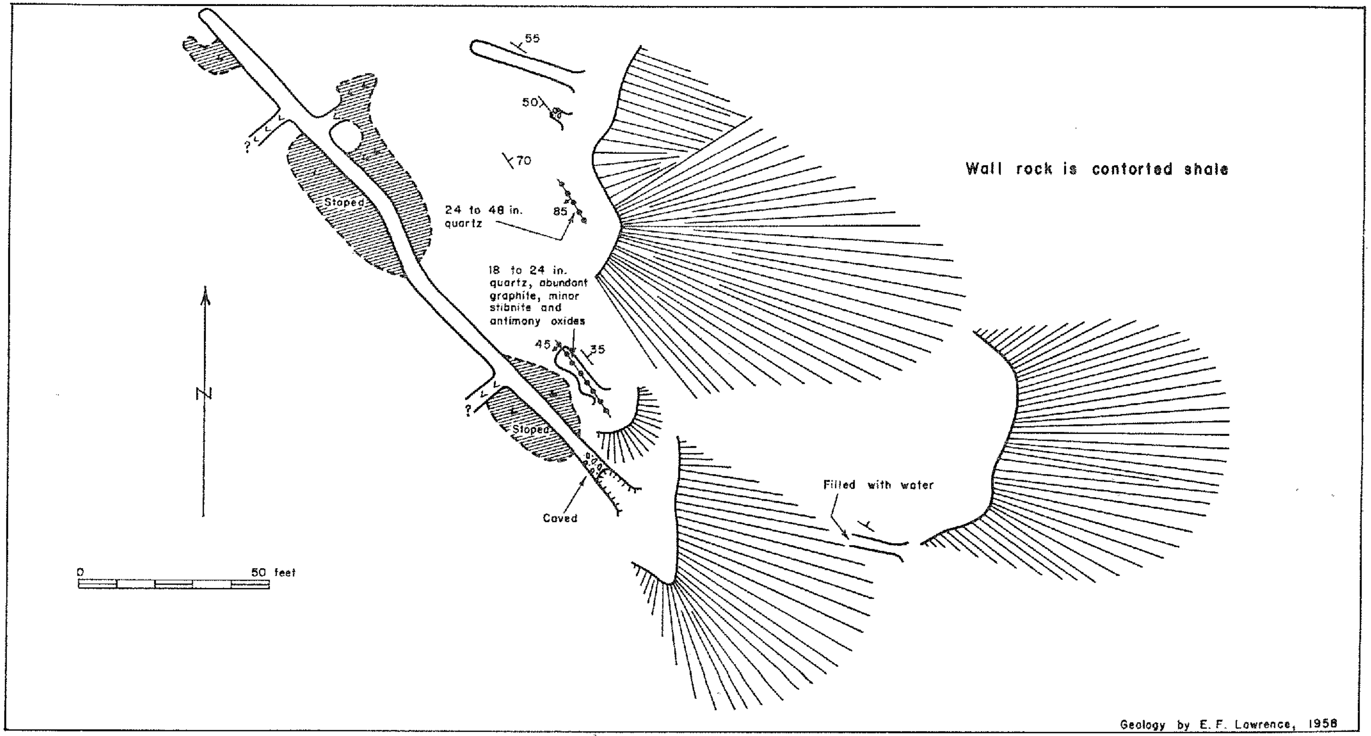

FIGURE 25. Geologic map of the Bray-Beulah mine, Lander County, Nevada.

The Bray-Beulah mine is on the west side of Big Creek, in the Toiyabe Range, 4.8 miles from the mouth of the canyon.

The mine was first located in 1864 for silver. In 1891 several shipments of antimony were made, some going to Swansea, Wales. A small brick furnace was built along the creek below the mine to treat the ore but apparently proved unsuccessful. Operations ceased in 1898.

The mine was reopened during World War I. Some ore was shipped to Magnolia Metals Co. in Matawan, New Jersey (Vanderburg, 1939, p. 35). Nearly 2,000 tons of ore averaging 60 percent antimony reportedly were produced up to 1918 (Layng, 1918).

The property consists of two patented claims, the Beulah and Genesee. In 1958, there were two long, and several short adits; one of the longer was caved, the other was filled with water. Figure 25 shows the workings of the Bray-Beulah mine.

Thin-bedded siliceous slates and shales of Silurian(?) Age crop out at the mine. Some highly altered rhyolite porphyry was found on one of the dumps but its relationship to other rocks is not known. Mineralization is concentrated in faults along several parallel anticlines and synclines. White quartz stringers, offset slightly by post-quartz movement, cut the highly contorted shales and slates.

The main vein strikes N. 30° W., dips 45°–85° SW., and varies in thickness from 6 to 48 inches. Stibnite occurs as single crystals, blebs, and pods up to 2 inches across in quartz. The stibnite commonly is associated with graphite and a small amount of pyrite. The antimony sulfide is partially altered to yellow and white antimony oxides. The white oxide is fibrous and resinous. The yellow oxide is powdery or resinous, and occurs as thin coatings along fractures in the veins and wall rock.

A grab sample of cobbed ore on the dump gave 34.04 percent antimony, 0.005 percent selenium, 1.5 ounces of silver per ton, and no gold.

Dry Canyon mine

Other names	Antimony No. 4, Beulah, Bray.
Location	Sec. 35, T. 18 N., R. 43 E.
Ownership	Mary J. Bray (1958).
Production	165 tons antimony (metal).
Base map	USGS Austin 15′ topographic quadrangle.

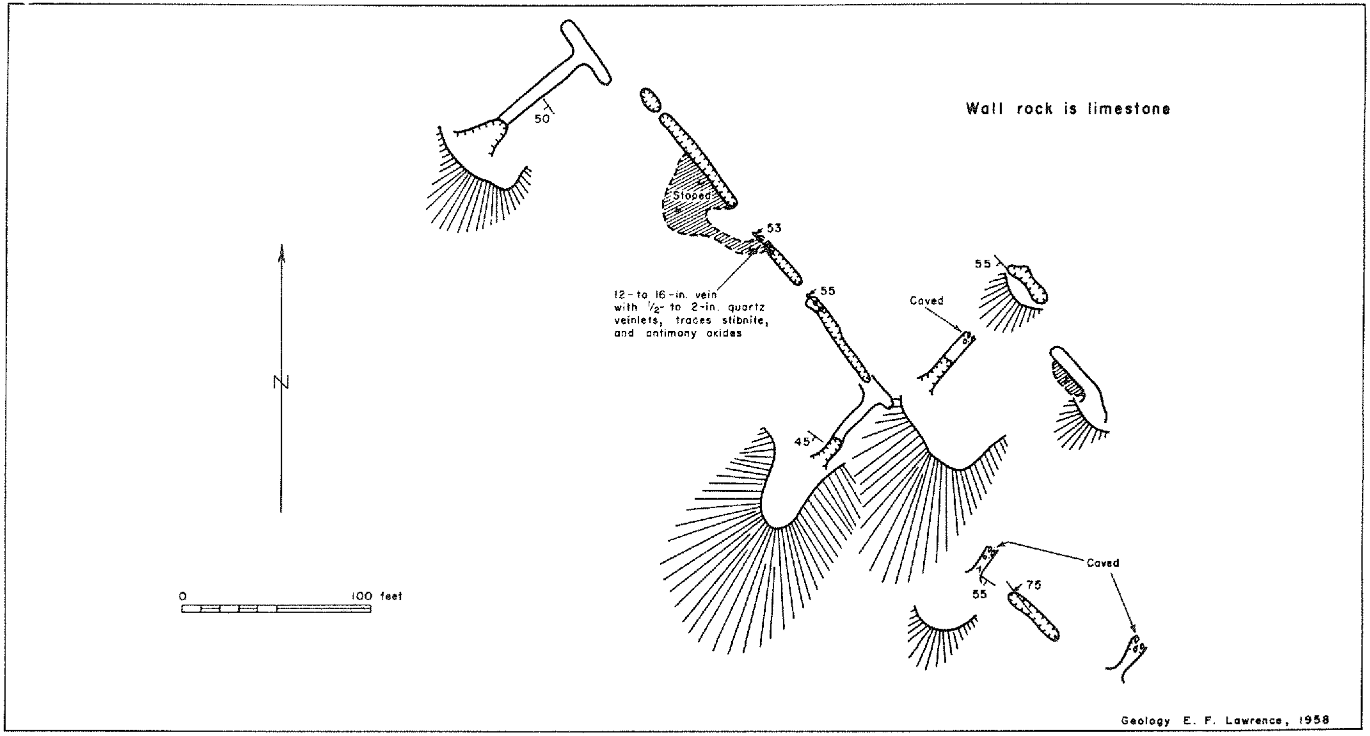

FIGURE 26. Geologic map of the Dry Canyon mine, Lander County, Nevada.

The Dry Canyon mine is at the head of Dry Canyon on the west flank of the Toiyabe Range, 1.8 miles from the mouth of the Canyon, and half a mile down the slope from the Antimony King mine.

During World War I, 300 tons of ore averaging 55 percent antimony were produced (Schrader, unpublished data, U. S. Geol. Survey). The mine is developed by numerous pits and five short adits totaling several hundred feet (fig. 26).

Gray thin-bedded arenaceous limestone, striking N. 60° W. and dipping 45°–50° SW., crops out at the mine. The main vein strikes N. 35° W. and dips 55° SW. It is 4 to 12 inches wide and consists principally of quartz. Small pods, blebs, and single crystals of stibnite associated with tetrahedrite, sphalerite, and pyrite occur in the quartz. The tetrahedrite and sphalerite probably were deposited earlier than stibnite. Stibnite is partially oxidized to fibrous white and resinous to powdery yellow oxides. Tetrahedrite is oxidized to azurite, and pyrite is oxidized to limonite.

Analyses of two ore samples taken from the Dry Canyon mine are shown in the following table:

No.	Description	Sb %	Au oz.	Ag oz.	Se %
187	Grab sample, dump	6.34	None	0.70	Tr.
188	Grab sample, open cut	4.64	None	0.84	Tr.

Hard Luck-Pradier mine

Other names.......... Pradier, Romano, Big Creek.
Location.......... Sec. 27, T. 17 N., R. 43 E.
Ownership.......... Big Creek Mining and Milling Co. (1958).
Production.......... 75 tons antimony (metal).
Base map.......... USGS Austin 15′ topographic quadrangle.

The Hard Luck-Pradier mine is in the Toiyabe Range on the west side of Big Creek, 4.6 miles from the mouth of the canyon.

In 1936, 30 tons of ore containing 50 percent antimony were shipped. In 1943, 100 tons of ore averaging 50 percent antimony were shipped to the Metals Reserve Co. stockpile at Battle Mountain. In 1953, 70 tons of ore assaying 18 percent antimony were mined. In 1958, 29,376 pounds of concentrates, containing 67.4 percent antimony and valued at $2,228, were shipped to the South American Minerals Co. in New York.

Mine openings include a lower adit 160 feet in length with its entrance just above creek level; three adits with lengths of 65, 80, and 85 feet, located higher on the hillside and at the upper

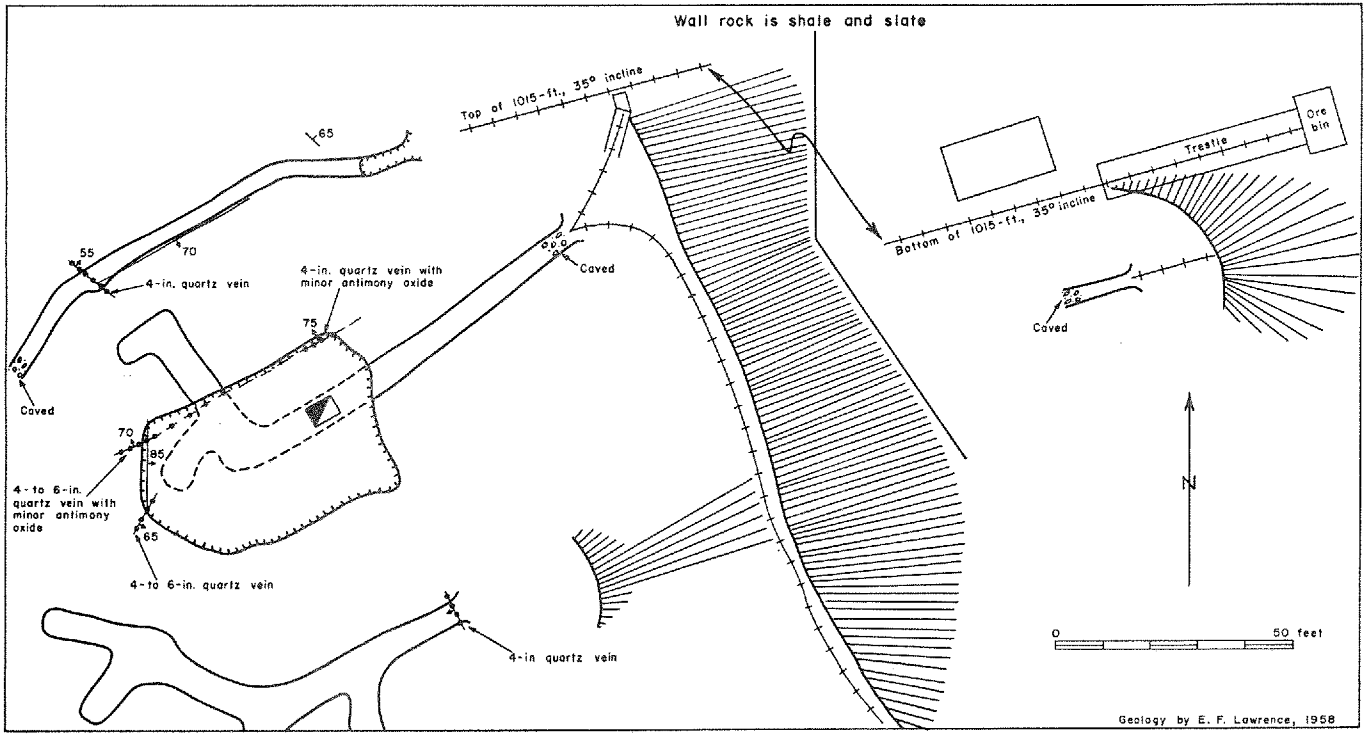

FIGURE 27. Geologic map of the Hard Luck-Pradier mine, Lander County, Nevada.

end of a 1,015-foot track; and an open pit on the slope above the upper adits. The lower adit and two of the upper adits are caved (fig. 27).

Gray to black shale and slate, striking N. 45° W. and dipping 60°–65° NE., crop out in the vicinity. The mine is in the north edge of a zone of faulting and folding striking N. 20° W.

Stibnite, tetrahedrite, and pyrite occur in a flat-lying body in silicified fault breccia recemented by quartz. The stibnite occurs as blebs, small pods, and single crystals. Tetrahedrite apparently was deposited simultaneously with the stibnite. Varicolored antimony oxides replace stibnite and tetrahedrite. Azurite and malachite form boxworks in the tetrahedrite. Some silver bromide reportedly is present.

Spencer claims

Aune (unpublished data, U. S. Bureau of Mines) reports the occurrence of antimony in the Spencer group of claims (Birch Creek prospect) in the Birch Creek mining district. John Spencer had a claim at the headwaters of Birch Creek in secs. 20 and 29, T. 18 N., R. 44 E. on which a small amount of antimony occurred (see USGS Roberts Mountains 1° topographic quadrangle). These probably are one and the same.

Other occurrences

Aberasturi mine. Ignacio Aberasturi is said to have produced 18 tons of ore assaying 45 percent antimony from the Reese River mining district in 1940. This ore probably came from the Bray-Beulah mine.

Gallagher ore. William Gallagher (private report, 1940) of Austin produced 25 tons of ore averaging 45 percent antimony in 1941. This probably is from the mill site in Austin that Gallagher bought at a tax sale, and may be the same ore produced and shipped to the mill by Aberasturi (see above) in 1940 (Sam Peacock, oral communication, 1958).

Mammoth mine. The Mammoth mine, reported to be on Big Creek (White, unpublished data, U. S. Geol. Survey), is part of the Antimony King group of patented claims.

Wang deposit. The Wang deposit, with the Genesee and Beulah claims, reportedly was owned in 1941 by J. F. Murphy, of Battle Mountain (White, unpublished data, U. S. Geol. Survey). This deposit, apparently adjacent to the Bray-Beulah mine, could not be located.

Reese River Mining District

The Reese River mining district in the Toiyabe Range is centered in Austin. Between 20 and 65 million dollars worth of gold, silver, copper, lead, and zinc have been produced since discovery in 1862, but the principal values were in silver (Ross, 1953, p. 46).

Both stibnite and antimonial silver minerals have been reported from the various mines in the district. Galena, sphalerite, chalcopyrite, arsenopyrite, tetrahedrite, proustite, covellite, chalcocite, argentite, pyrargyrite, stephanite, and polybasite also occur in the veins (Ross, 1953, p. 48, and Hill, 1915, p. 105). Ross (1953, p. 57) found stibnite only in the Silver Cliff mine but reported that it had been found in other places. Tetrahedrite is widely distributed in the veins and is intimately intergrown with galena; proustite forms irregular blebs in the tetrahedrite. Ross (1953, p. 72) believed that the antimonial-silver ores are genetically related to the quartz monzonite.

Amador mine

The Amador mine is 2 miles north of the Silver Cliff mine in San Francisco Canyon, sec. 19(?), T. 20 N., R. 44 E. (see U. S. 1 : 250,000 scale topographic map, Millett sheet).

The property, consisting of 16 unpatented claims, is owned by Walter Francis, Charles Kearns, and Harry Nakashima, of Austin, Nevada. It is developed by the 700-foot Amador tunnel and a 290-foot inclined (20°) shaft (fig. 28). The country rock at the mine consists of slate and shale.

The vein strikes northwest and dips 20°–30° NE. It ranges from 12 to 96 inches in width and consists principally of banded quartz. Greenhalgh (private report, 1941) reported that pyrargyrite, proustite, polybasite, and stephanite occur in the vein. During the examination made for this report, only traces of silver-antimony sulfide were found. Two samples taken across the vein contained 4.64 and 2.16 ounces of silver per ton but no antimony or gold.

Silver Cliff mine

The Silver Cliff mine is in San Francisco Canyon in sec. 32, T. 20 N., R. 44 E., in the Yankee Blade area (see U. S. 1 : 250,000 scale topographic map, Millett sheet).

No ore has been shipped but a small amount of ore was mined from the 130-foot level by a leaser (W. C. Francis, oral communication, 1957). The mine is developed by a 207-foot inclined (30°)

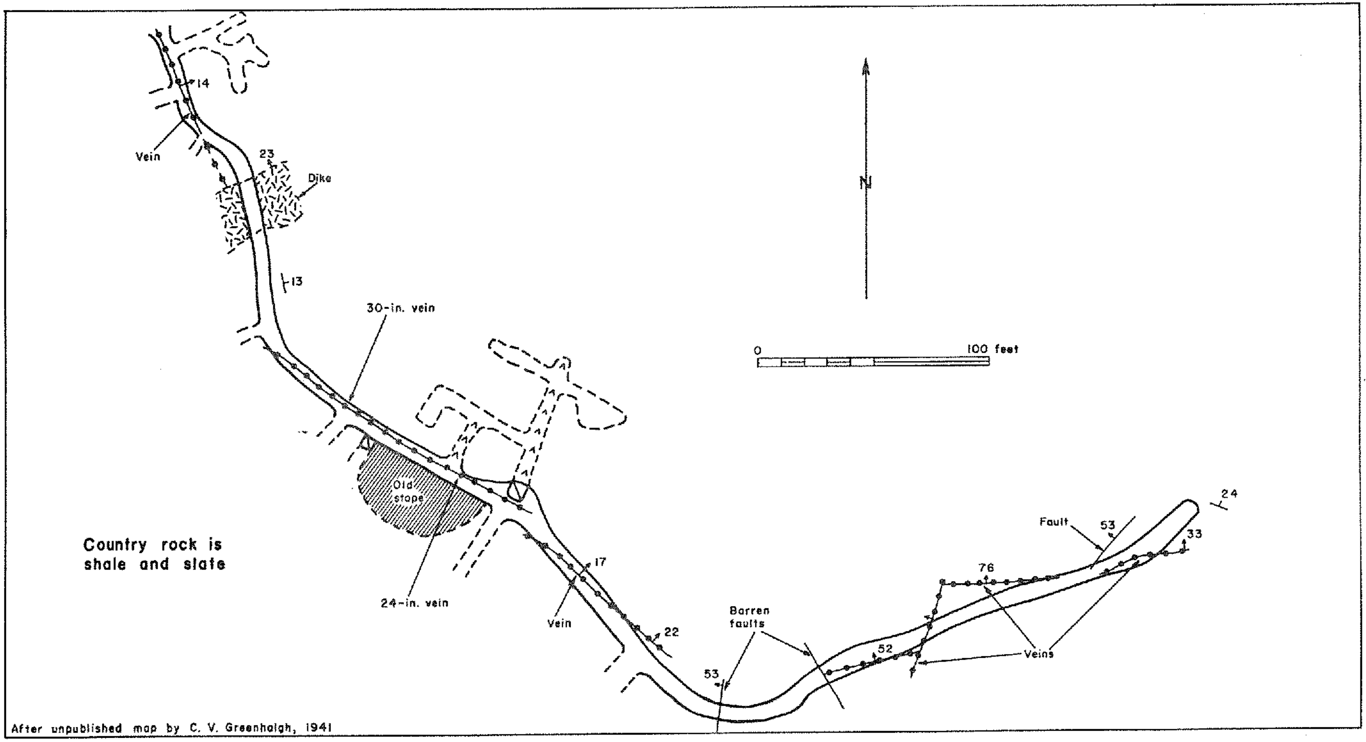

FIGURE 28. Geologic map of the Amador mine, Lander County, Nevada.

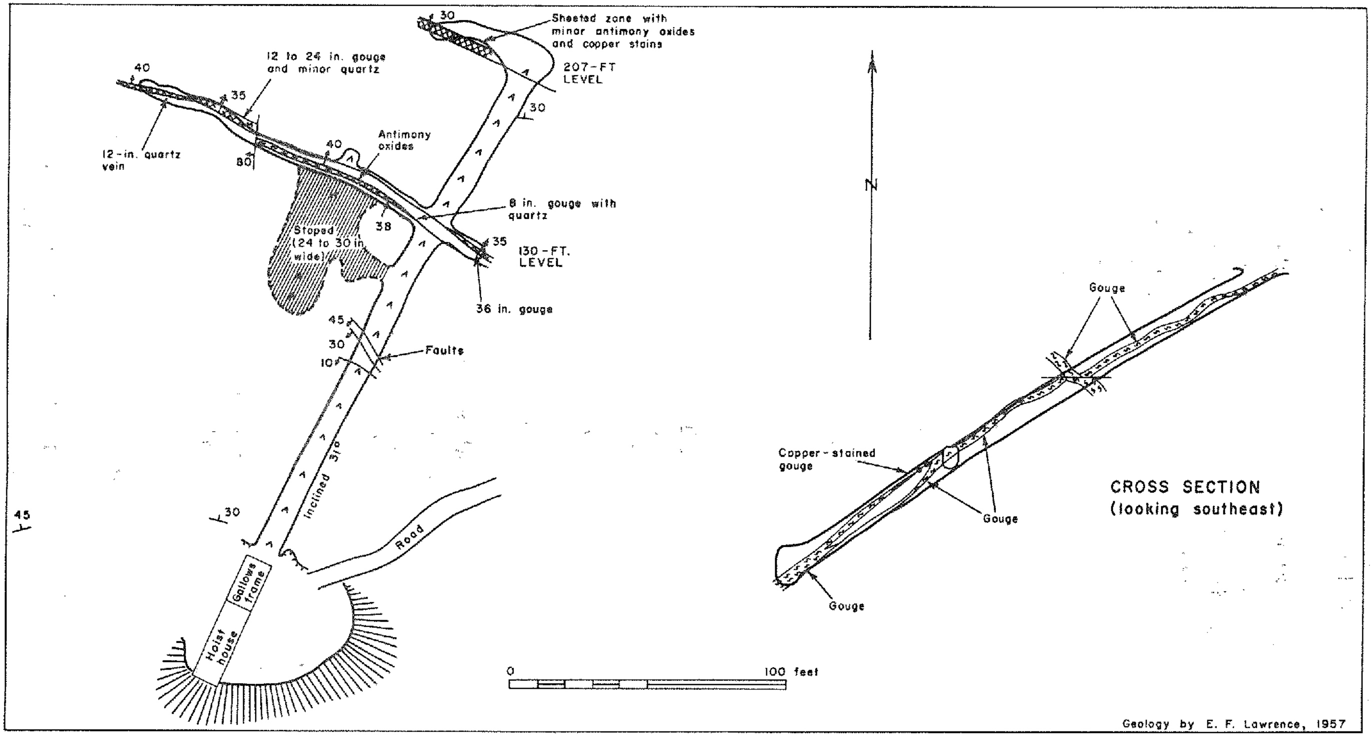

FIGURE 29. Geologic map and cross section of the Silver Cliff mine, Lander County, Nevada.

shaft, with 122 feet of drifts on the 130-foot level, 40 feet of drifts on the 207-foot level, and some stoping above the 130-foot level (fig. 29).

Thin-bedded carbonaceous Cambrian quartzite and shale, striking N. 75° W. and dipping 25°–30° NE., crop out at the mine. Less than 150 feet from the workings Jurassic(?) quartz monzonite has intruded the sedimentary rocks (Ross, 1953, p. 56–71). A vein, striking N. 60° W. and dipping 30°–40° N., cuts the quartzite. At 70 feet the vein is 10 to 14 inches wide and composed principally of gouge and minor yellow antimony oxide; on the 130-foot level it widens to 24 inches and is mostly gouge with minor quartz; at 150 feet the vein is 10 inches wide and copper-stained; and on the 207-foot level it is 14 inches wide and splits into stringers. No sulfide minerals were observed in the mine, but stibnite and tetrahedrite were present in sacked ore on the dump. In this material, blebs and small pods of stibnite and tetrahedrite occur together in quartz. Abundant white and yellow oxides replace stibnite. Some leached cavities appear to have contained arsenopyrite.

San Miguel mine

The San Miguel mine is on the north edge of the mouth of Crow Canyon in secs. 25 and 36, T. 19 N., R. 43 E. (see USGS Austin 15′ topographic quadrangle). It is owned by Maude Mayenbaum Norris, of Mountain View, California. Development consists of a short, caved adit and a number of shallow shafts and open cuts, (fig. 30).

Jurassic(?) quartz monzonite cropping out at the mine is cut by three veins. The main vein strikes N. 55° E. and dips 50° SE., is 16 to 18 inches wide, and is composed principally of brecciated quartz recemented by quartz. A second quartz vein 10 to 12 inches wide, parallels the main vein to the southeast. A third quartz vein 6 to 12 inches thick, striking N. 85° E. and dipping 35° S., may be a split from one of the other veins. No antimony minerals were noted in the mine or on the dump, except for a small amount of powdery, yellow antimony oxide coating the wall rock near the third vein. Green secondary copper minerals stain the quartz of the main vein. Locally, the quartz monzonite is argillized and silicified along the margins of the veins.

Other Occurrences in Lander County

Wildhorse mine

The Wildhorse mine is in the Wildhorse mining district in sec. 16(?), T. 23 N., R. 40 E., a few miles southwest of the common

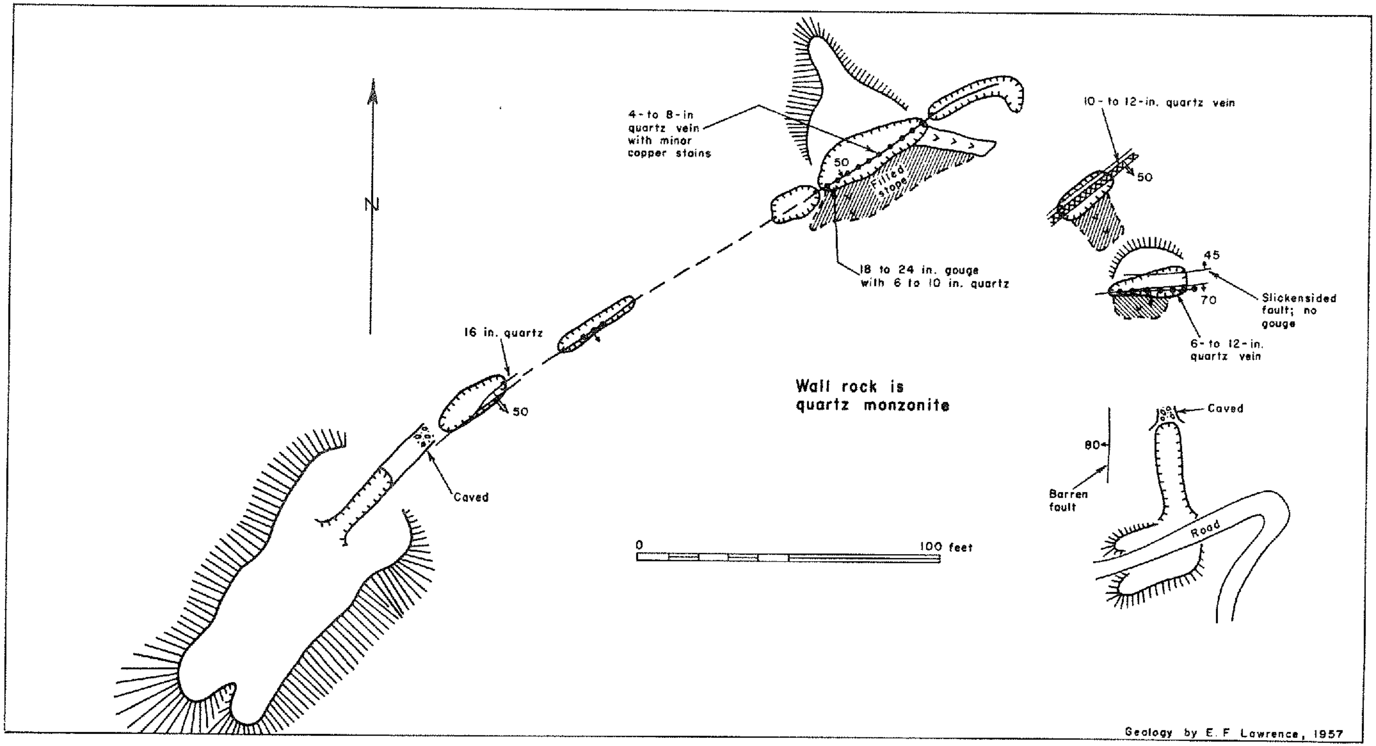

FIGURE 30. Geologic map of the San Miguel mine, Lander County, Nevada.

corner of Lander, Churchill, and Pershing Counties (see U. S. 1 : 250,000 scale topographic map, Millett sheet).

Production was 883 flasks of mercury (Bailey and Phoenix, 1944, p. 112). Development includes a number of small pits, trenches, glory holes, and adits.

Lower Triassic sandstone here is overlain by Middle Triassic limestone, which varies from 20 to 30 feet in thickness and is overlain by red shale (Dane and Ross, 1942, p. 266). Cinnabar occurs in fractures in silicified sandstone and limestone as thin, powdery films and coarsely crystalline pods and blebs. Pyrite and stibnite are associated with the cinnabar (Dane and Ross, 1942, p. 272). Only a few scattered blebs and single crystals of stibnite and minor yellow antimony oxides were noted by the writer.

LINCOLN COUNTY

Western mine

A large antimony deposit, said to belong to the Western Mercury and Uranium Co., of Las Vegas, has been reported 15 miles south of the Lincoln mine. Supposedly the ore zone is 10 to 30 feet wide in rhyolitic tuff. A 400-ton stockpile of ore containing 20 percent antimony is reported. Reports concerning this deposit could not be confirmed.

LYON COUNTY

De Longchamps prospect

Location	Sec. 34, T. 19 N., R. 24 E.
Ownership	Curtiss-Wright Corp.
Antimony production	None.
Base map	USGS Churchill Butte 15′ topographic quadrangle.

The De Longchamps prospect is in the Ramsey mining district in the Virginia Range, 1 mile north of the Tallapoosa mine, and 6 miles northwest of Silver Springs. No work has been done.

Tertiary volcanic rocks, principally dacite, andesite, and basalt flows, are cut by a completely silicified shear zone, striking N. 70° W. and dipping 60° S. It is 12 to 40 feet wide and over 600 feet long as disclosed by numerous prospect pits and adits.

Stibnite occurs as scattered pods, blebs, single crystals, and rosettes in the silicified volcanics and in narrow stringers of chalcedony and opal. The rosettes are up to 2 inches across with individual blades up to 1 inch long. Cinnabar is closely associated with stibnite as small blebs and tiny veinlets.

Stibnite is commonly partially altered to white and yellow antimony oxides. The white oxide is pseudomorphic after needles of stibnite. Powdery yellow oxide is enclosed by opaline material. Red oxysulfide (kermesite?) is common.

A sample from an area containing stibnite in chalcedony and opal assayed 0.68 percent antimony, 0.02 percent mercury, a trace of gold, and no silver.

MINERAL COUNTY

Candelaria Mining District

The Candelaria mining district, described by Page (1959), is approximately 17 miles south of Mina. Production is valued between 15 and 20 million dollars, principally from oxidized silver ore (Page, 1959, p. 10). The primary ore minerals were pyrite, arsenopyrite, sphalerite, chalcopyrite, galena, and jamesonite. Gold, silver, lead, antimony, barite, serpentine, and turquoise also have been produced.

Petrel mine

The Petrel mine is in Pickhandle Gulch, 1,300 feet south of the Belle shaft of the Argentum Mining Co. It lies in an area of serpentine intruded by dikes of intermediate composition (Page, 1959, pl. 1).

Aune (unpublished data, U. S. Bureau of Mines) reported antimony associated with gold, silver, and lead. Mapping and sampling for this study failed to reveal any antimony minerals, but they did occur in minor amounts in the silver ore.

Potosi mine

Other names .... New Potosi.
Location .... Sec. 5, T. 3 N., R. 35 E.
Ownership .... G. A. Peterson (1959).
Antimony production .... Estimated 633 tons (metal).
Base map .... USGS Hawthorne 1° topographic quadrangle.

The Potosi mine is located 1 mile west of Candelaria. From 1948 through 1952, 11,840 tons of ore valued at $35 to $75 per ton were produced. According to Page (1959, p. 58), the metal content was 0.5 to 0.6 ounces of gold and 8 to 12 ounces of silver per ton; and 8 to 12 percent lead, 4 to 6 percent antimony, 12 to 15 percent iron oxide, 0.5 percent copper, and 0.5 percent zinc. The mine is developed by several adits, shafts, and winzes, and underground workings totaling over a thousand feet. The main

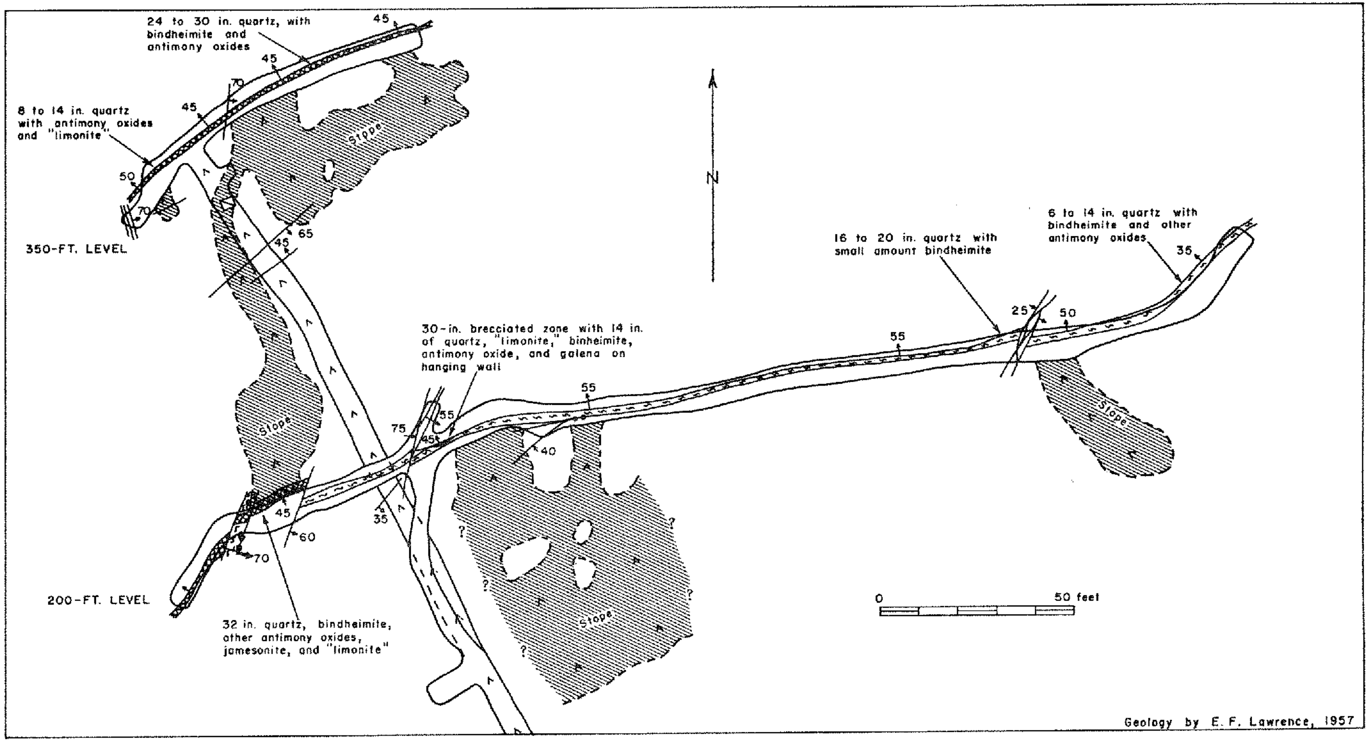

FIGURE 31. Geologic map of the winze area, Potosi mine, Mineral County, Nevada.

inclined (45°) shaft is 360 feet in length. Considerable stoping has been done on the adit level, and on the 200-, 300-, and 350-foot levels in the inclined shaft.

The mine is mainly in the Candelaria Formation where it is intruded by several acidic dikes. The Diablo "grit" forms the footwall of the vein in the main adit and is believed to be a stratigraphic control. Page (1959, p. 53) mapped the geology of the main adit level.

The vein strikes N. 70° E. and dips 45° N. In the winze area (fig. 31), the vein varies in thickness from 8 to 36 inches, and consists of gouge, varying amounts of quartz, and minor calcite. Several cross faults, which strike N. 20° E. and dip steeply east, offset the vein. Blebs, small pods, and veinlets of the antimony minerals, jamesonite and bindheimite, occur in the quartz. Some pods are up to 30 inches across, and commonly consist of cores of jamesonite surrounded by brown, yellow, orange, and green, banded bindheimite. Jamesonite commonly is fine-grained, yet fibrous. The enclosing bindheimite commonly retains the fibrous texture of the jamesonite but the bindheimite normally is powdery to vitreous. Some masses of pure jamesonite are up to 12 inches across. Pyrite and minor tetrahedrite and galena commonly are closely associated with the jamesonite. Yellow and white antimony oxides are present. A sample of ore from a stope on the 300-foot level assayed a trace of gold and 10.34 ounces of silver per ton; and 32.70 percent antimony, 32.34 percent lead, and 0.018 percent selenium.

Garfield Hills

The Garfield Hills lie between Mina and Hawthorne, and join the Excelsior Mountains on the eastern end. This area is underlain by a series of Jurassic-Triassic sediments, metasediments, and metamorphic rocks, which have been intruded by Jurassic rocks. The mineralization is associated with the pre-Tertiary rocks, although some veins cut Tertiary rocks. Several hundred thousand dollars worth of gold, silver, lead, copper, antimony, and tungsten have been produced.

Antimony Blossom prospect

Other names	Antimony Queen.
Location	Sec. 14, T. 6 N., R. 34 E.
Ownership	Salvador Urrutia (1956).
Antimony production	None.
Base map	USGS Hawthorne 1° topographic quadrangle.

The Antimony Blossom prospect is on the west slope of the mountains in the Silver Star mining district 5 miles west of Mina. It has been developed by two shallow shafts and an open cut (fig. 32).

Shale, chert, and metavolcanic rocks of the Middle Triassic Excelsior Formation crop out in the mine area. The main vein, striking N. 45°–60° E. and dipping 70° NW., is 12 to 24 inches wide, and consists of gouge and minor brecciated quartz. A second vein, striking N. 25° E. and dipping 75° NW., is 6 to 12 inches wide. At the open cut, the footwall is iron-stained and altered

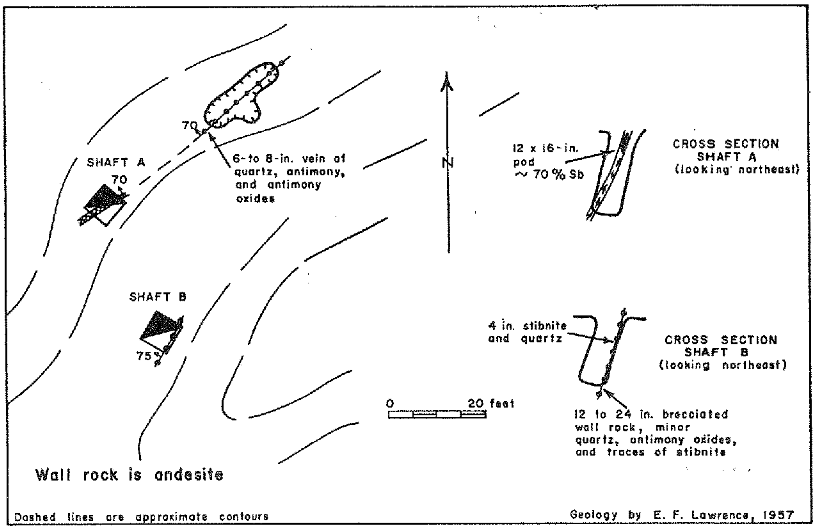

FIGURE 32. Geologic map and cross sections of the Antimony Blossom prospect, Mineral County, Nevada.

andesite; the hanging wall is kaolinized andesite. Single crystals, blebs, pods up to 16 inches across, and veinlets of stibnite up to 4 inches in width occur in the veins. The main vein averages 3 to 5 percent antimony. A sample from the open cut averaged 23.49 percent antimony, 5.40 ounces of silver per ton, and no gold or selenium. White antimony oxide occurs as pseudomorphs after bladed stibnite. Yellow antimony oxide occurs as pseudomorphs after small single crystals of stibnite and as powdery coatings on quartz and the wall rock adjacent to the veins.

Hartwick prospect

Other names........April Fool, Edd's, Smith, Mindora, Red Butte.
Location........Sec. 5, T. 7 N., R. 34 E.
Antimony production........None.
Base map........USGS Hawthorne 1° topographic quadrangle.

The Hartwick prospect is in the Garfield mining district on the northern flank of the Garfield Hills 3 miles southwest of Luning. It is developed by 2 trenches and a 12-foot shaft.

In this vicinity, limestone, metavolcanics, and metasediments of the Upper Triassic Luning Formation (Ferguson and Muller, 1949, pl. 1) have been intruded by quartz monzonite. The limestone strikes N. 40° E. and dips 60° N. In the trenches, stibnite occurs in a 1- to 4-inch vein, striking N. 70° E. and dipping 65° S. Pods, blebs, and single crystals of stibnite are found in quartz associated with limonite pseudomorphs after pyrite. Small pods and single crystals of scheelite are common in the shallow shaft but no stibnite is present. Commonly the stibnite has been partially replaced by intimately intermixed fibrous white and powdery to vitreous yellow antimony oxides. The yellow oxide also coats fractures.

Julia mine

The Julia mine is in the Santa Fe mining district, 6 miles west of Luning, in the canyon west of the Hartwick property in sec. 18, T. 7 N., R. 34 E. Hill (1915, p. 167) reported that antimony occurs with fine-grained galena in irregular lenslike masses of limestone. The mine is developed by a 700-foot adit and two shafts. No antimony minerals were found on the dump at the time of this examination.

Kernick mine

Location........Sec. 6 (?), T. 5 N., R. 35 E.
Ownership........Mrs. Grace Rogers of Mina (1940).
Antimony production........None.
Base map........USGS Hawthorne 1° topographic quadrangle.

The Kernick mine is in the Silver Star (Gold Range) mining district on the east flank of the Excelsior Mountains, about 2½ miles west of Sodaville.

The mine is developed by a 150-foot shaft connected to an adit. A glory hole connects with the adit 72 feet from its portal. In 1958, the portal was locked and the other workings were inaccessible.

A vein, striking N. 35° W. and dipping 50° SW., cuts biotite andesite intruded by rhyolite. The mineralization apparently is associated with the rhyolitic intrusion (Pine, unpublished data, U. S. Bureau of Mines).

The vein is composed principally of vuggy quartz. Stibnite occurs as single crystals, pods, and lenses in quartz and as rosettes on quartz and silicified rhyolite. The stibnite crystals most commonly are needle-like in habit, but when found in lenses they consist mainly of bladed aggregates. Stibnite commonly is partially altered to earthy-to-fibrous, white, antimony oxide, and earthy-to-vitreous, yellow, antimony oxide. The yellow oxide forms coatings along fractures.

Gold reportedly occurred in small lenses and veinlets of quartz in the rhyolite.

Lowman mine

Other names	Mary E, Anna E, Beard, Jenney, Johnson, Wamsley, Thorne.
Location	Sec. 29(?), T. 7 N., R. 32 E.
Ownership	L. M. Beard Wyatt (1950).
Antimony production	3 tons (metal).
Base map	USGS Hawthorne 1° topographic quadrangle.

The Lowman mine is in the Hawthorne mining district, about 3½ miles east of Pamlico and 1 mile southwest of Ashby.

In 1932, 42 tons of ore containing 7 percent antimony were shipped to the Midvale Smelter near Salt Lake City. The mine is developed by several separate workings. The westernmost includes an 87-foot inclined (45°) shaft with 117 feet of drifting on the adjoining adit and on the 45- and 60-foot levels driven from the inclined shaft; other workings include a 17-foot vertical shaft, two adits (32 and 75 feet long), and an open pit (fig. 33).

Sedimentary rocks and metavolcanics of the Excelsior, Luning, and Sunrise Formations of Triassic and Jurassic Age have been intruded by aplitic dikes in the vicinity of the mine. The inclined shaft is in metavolcanics of the Excelsior Formation which appear to have been of pyroclastic origin. The Ashby thrust is nearby (Ferguson and others, 1954). An adit one-fourth of a mile to the north is in highly contorted shale of the Sunrise Formation.

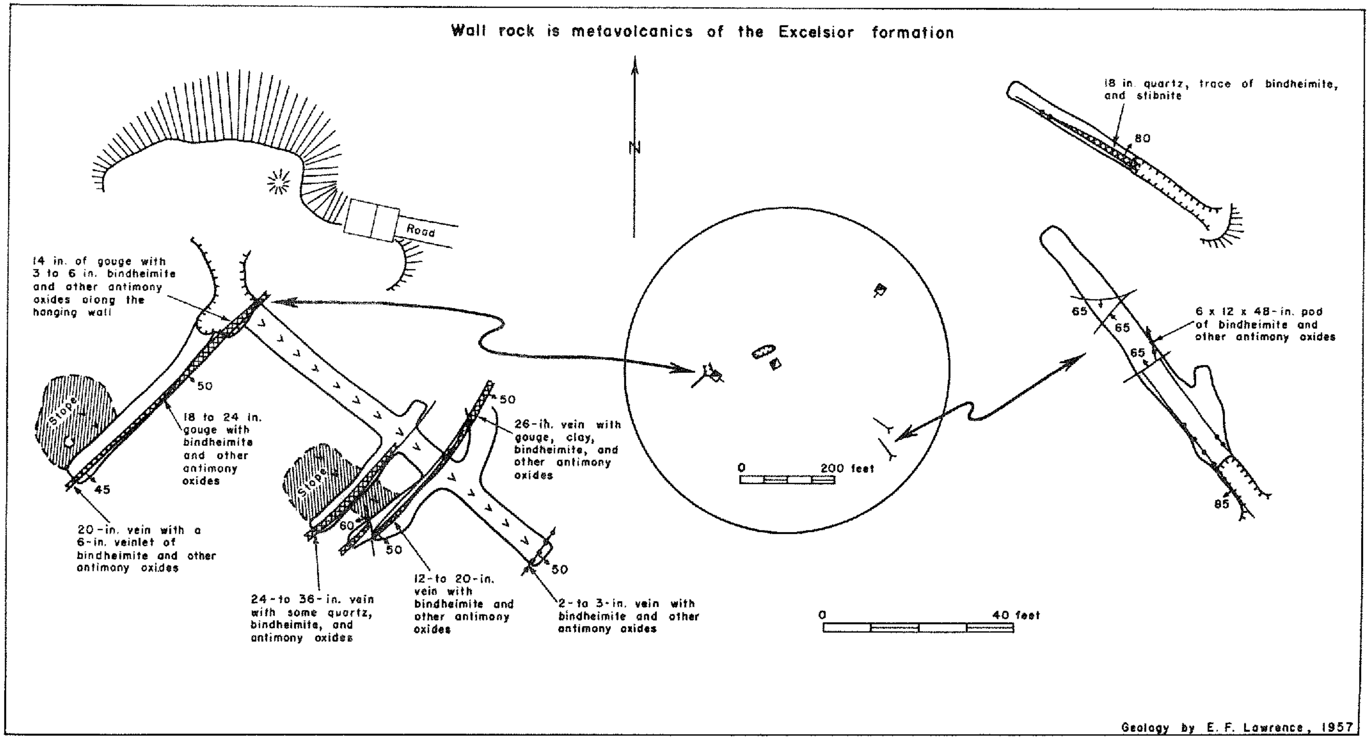

FIGURE 33. Geologic map of the Lowman mine, Mineral County, Nevada.

The main vein, striking N. 45° E. and dipping 40°–50° SE., is explored by workings from the inclined shaft. On the adit level, the vein averages 18 inches in thickness and consists of brecciated quartz recemented by later quartz. On the 45-foot level the vein is 36 inches wide but pinches to 2 inches at the bottom of the inclined shaft. Antimony occurs as bindheimite which appears to be an alteration product of fibrous jamesonite. The yellow to orange, powdery to vitreous bindheimite is present as blebs, pods, and veinlets up to 8 inches wide in the quartz, most commonly along the hanging wall of the vein. Yellow antimony oxide also is present. Pyrite is common as residual blebs in pods and cubes of brown limonite, both in the quartz and wall rock. The metavolcanics have been completely sericitized along the vein. Analyses of four ore samples taken from the mine are as follows:

No.	Description	Au oz.	Ag oz.	Sb %	Se %	Pb %	As %
22	30-in. vein, 45-ft. level	None	0.70	1.96	......	......	......
23	26-in. vein, 60-ft. level	None	0.28	1.64	None	0.96	Tr.
24	15-in. vein, adit level	Tr.	0.88	3.28	......	......	......
165	22-in. vein, 12-ft. level	None	0.40	4.06	......	......	......

The lower adit, 350 feet to the south, follows a narrow vein striking N. 35° W. and dipping 85° W. This vein contains only minor amounts of bindheimite and other antimony oxides.

Pilot Mountain Mining District

The Pilot Mountain mining district is 5 miles east of Mina. Intermittent production in the district up to 1943 has yielded 5,000 flasks of quicksilver.

Mesozoic sedimentary rocks and rocks of the Triassic Excelsior and Luning Formations and the Jurassic Dunlap Formation have been intruded by Tertiary igneous rocks and overlain by Tertiary volcanic rocks. Jurassic thrust-faulting has complicated the picture (Bailey and Phoenix, 1944, p. 118).

The principal ore mineral is cinnabar. Antimony is present as bindheimite, valentinite, and stibiconite, which is associated with the cinnabar. The geology of the district and individual mines has been described in detail by Foshag (1927), Phoenix and Cathcart (1952), Bailey and Phoenix (1944, p. 118), and Ferguson and others (1953).

Drew mine

The Drew mine, located in sec. 14, T. 6 N., R. 36 E. (see U. S. 1:250,000 scale topographic map, Tonopah sheet), contains crystalline and earthy cinnabar associated with stibiconite, valentinite, quartz, calcite, sphalerite, calamine, and bindheimite

(Bailey and Phoenix, 1944, p. 121). Only traces of yellow antimony oxides were found on the dump during this examination.

Lost Steer mine

The Lost Steer mine is near the top of Cinnabar Hill, south of the Mina Development Co. mine, in sec. 15, T. 6 N., R. 36 E. (see U. S. 1: 250,000 scale topographic map, Tonopah sheet). It is in the Mina Development Co. group of claims.

Bailey and Phoenix (1944, p. 126) report that stibnite, stibiconite, and valentinite are associated with cinnabar was confirmed by this study.

Mina Development Company mine

The Mina Development Co. mine is in sec. 13, T. 6 N., R. 36 E. (see U. S. 1: 250,000 scale topographic map, Tonopah sheet). Limestone and shale of the Dunlap Formation are exposed in the vicinity of the mine. Stibnite is common in the main adit, and in the prospect pits and short adits to the east and west. Stibiconite and valentinite also are associated with cinnabar (Bailey and Phoenix, 1944, p. 128).

On the Booth-Wardell claim, a 10-inch vein strikes N. 10° W. and dips 25° W. It contains cinnabar as veinlets, disseminations, and coatings along fractures in limestone. A pod of stibnite also contains small blebs of cinnabar.

Reward mine

The Reward mine in sec. 16, T. 6 N., R. 36 E. (see U. S. 1: 250,000 scale topographic map, Tonopah sheet) is in brown quartzitic sandstone overlain by sandy limestone and red conglomerate. Bailey and Phoenix (1944, p. 130) report that grains of stibnite and calcite are disseminated through the country rock. Only a few blebs of stibnite and considerable yellow and white antimony oxides were seen by this writer.

Other Occurrences in Mineral County

Beeler prospect

The Beeler (Valley View, Smith, Rosebud) prospect is in the Santa Fe mining district on the west flank of the Gabbs Valley Range in T. 9 N., R. 35 E., 9½ miles north of Luning (see USGS Hawthorne 1° topographic quadrangle). This probably is the same as the Smith prospect, reported by White (unpublished data, U. S. Geol. Survey) as being 2 miles up New York Canyon and then 10 miles to the northwest. The prospect is developed by four pits.

A 6- to 30-inch-wide vein, striking northwest, contains tetrahedrite, azurite, malachite, pyrite, and antimony oxides. Tetrahedrite occurs as small pods and blebs in quartz, and is partially oxidized to azurite, malachite, and a small amount of powdery to earthy, yellow and white coatings of antimony oxide. A grab sample from a small stockpile assayed 5.12 percent antimony, 9.4 percent copper, and 0.02 ounce of gold and 12.48 ounces of silver per ton.

Benway mining district

The Benway mining district, 10 miles north of Schurz, includes several small mines producing gold, silver, and copper. Schrader (1947, p. 292) described the geology of the district. The country rock consists of Jurassic-Triassic limestone, shale, and sandstone which has been intruded by Mesozoic quartz monzonite, granodiorite, and diorite. There are more than ten veins in the district. They strike east-west and dip steeply south; they are 3 to 20 feet wide and consist principally of gouge with varying amounts of quartz, argentite, cerargyrite, pyrite, malachite, and minor stibnite.

Reservation Hill prospect. Stibnite reportedly occurs at the Reservation Hill prospect in sec. 5, T. 14 N., R. 28 E., 7 miles northwest of Schurz (Aune, unpublished data, U. S. Bureau of Mines) (see USGS Carson Sink 1° topographic quadrangle). Two shallow shafts explore a narrow vein which strikes toward the north and dips 35° to the south. The vein is 1 to 3 inches wide and contains minor amounts of stibnite and stibiconite associated with a gangue of quartz and calcite. The prospect appears to be the one mentioned by Schrader (1947, p. 292) in the Benway mining district.

Bismark prospect

Other names.................. Rea.
Location.................. Sec. 5, T. 6 N., R. 30 E. and sec. 32, T. 7 N., R. 30 E.
Antimony production.......None.
Base map.................. USGS Powell Mountain 15′ topographic quadrangle.

The Bismark prospect is in the Hawthorne mining district on the west flank of the Wassuk Mountains in the saddle between Alum and Willow Creeks 1½ miles from the mouth of Willow Canyon and 2 miles south of the Lucky Boy mine. It is developed by a pit and a 17-foot adit with a 15-foot vertical winze.

The workings are in granodiorite. Andesite crops out to the west. William Rea (White, unpublished data, U. S. Geol. Survey) reported the workings to be "350 feet long, 50 feet wide, and 100 to 150 feet deep." A field examination made for this study located only two small specimens containing yellow antimony oxide. These specimens occurred in a 4- to 18-inch vein, striking N. 55° W. and dipping 85° SW., associated with minor quartz, pyrite, arsenopyrite, and green copper stains.

Broken Hills mine

Antimony was reported in the silver-lead-zinc ore from the 135-foot level of the Broken Hills mine in T. 14 N., R. 35 E. (Nevada State Journal, June 11, 1948). Schrader (1947, p. 131) states that cerargyrite, argentite, proustite, pyrargyrite, galena, sphalerite, and bindheimite occur at this mine. The antimony minerals apparently are scattered sporadically through the mine, but an examination of the dumps failed to disclose any antimony minerals.

Happy Return mine

Other names	Rechel.
Location	Sec. 28 (?), T. 14 N., R. 32 E.
Ownership	Anna F. Rechel.
Antimony production	2½ tons (metal).
Base map	U. S. 1:250,000 scale topographic map, Reno sheet.

The Happy Return mine is in the Rawhide district on the west flank of Big Kassock Mountain, 3.3 miles northeast of Rawhide.

In 1942 and 1943, two tons of ore containing 43 percent antimony were produced. The property consists of nine claims, the Happy Return and Happy Return Nos. 1 through 8. The main vein is developed by a 35-foot inclined (70°) shaft with 55 feet of workings on the 35-foot level, and a 19-foot inclined (65°) shaft with 40 feet of workings on the 19-foot level connecting with a vertical shaft. A 40-foot shaft 169 feet to the north was sunk on another vein. Several short adits explore the other claims, but no ore has been found (Anna F. Rechel, personal communication).

The mine is situated in granodiorite which has intruded undifferentiated Triassic and Jurassic sedimentary and volcanic rocks. The granodiorite immediately adjacent to the veins is sericitized; this grades outward into argillized rock. The main vein strikes N. 85° E. to N. 70° W. and dips 65°–80° N. The average strike is N. 80° W. and the average dip 65° N. (fig. 34). The vein is 12 to 30 inches wide and consists principally of clay and gouge in

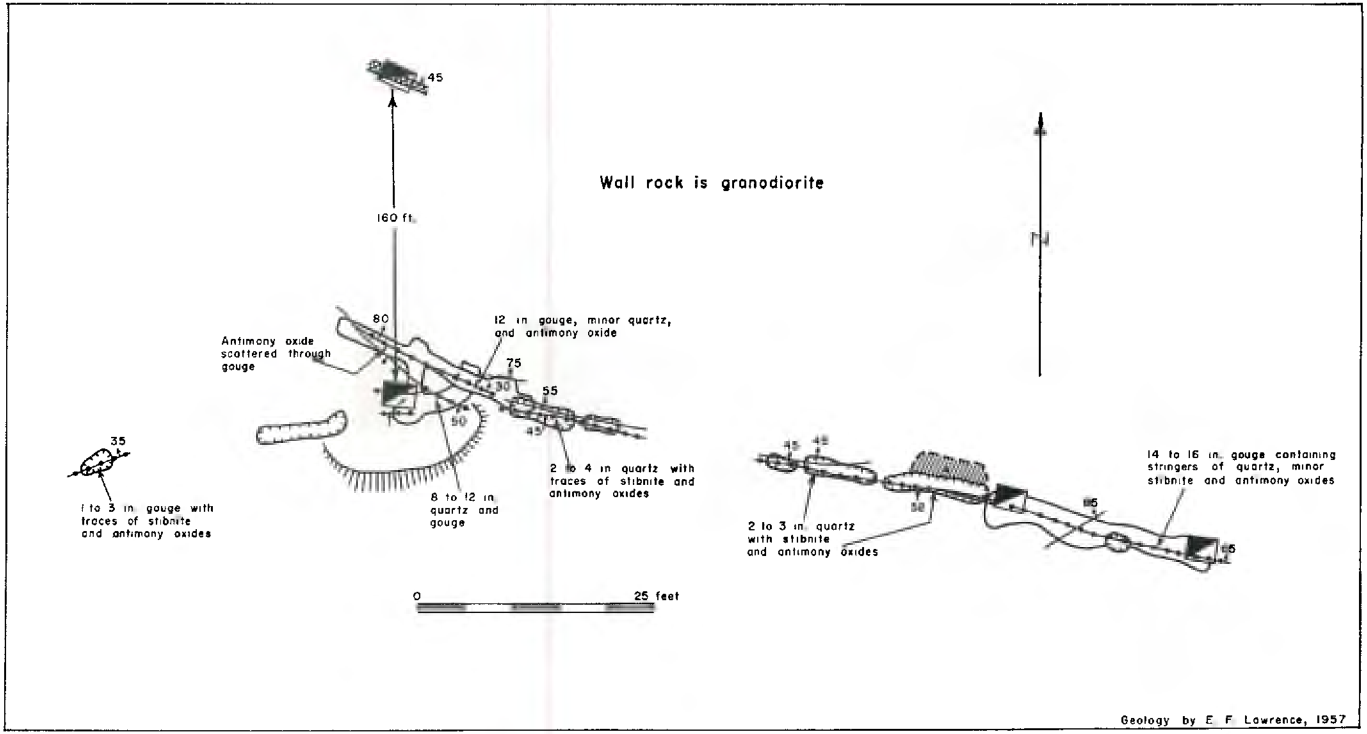

FIGURE 34. Geologic map of the Happy Return mine, Mineral County, Nevada.

which 1- to 12-inch veinlets of quartz occur sporadically. Locally the vein has been offset up to 10 feet by cross faulting. A second vein, striking N. 65° W. and dipping 45° S. is exposed in the northern shaft. This contains 48 to 60 inches of milky quartz and minor galena. Stibnite occurs as small single crystals, blebs, small pods, and veinlets up to 2 inches wide in the veins.

Much of the stibnite is either completely or partially altered to white and green antimony oxides. The green oxide is vitreous to earthy and the white oxide is powdery to earthy.

Antimony and other values found in six ore samples from the Happy Return mine are given below:

No.	Description	Au oz.	Ag oz.	Sb %	Se %	As %
1	12-in. vein, 35-ft. level, 35-ft. inclined shaft	None	0.70	2.9	....	None
2	2-in. vein, trench near 35-ft. inclined shaft	0.01	0.78	9.8	....	None
3	Grab sample, stockpile	None	0.42	None	....	Tr.
4	Grab sample, stockpile	Tr.	0.72	15.7	None	None
5	48-in. vein	None	1.01	2.9	None	None
11	60-in. vein	Tr.	2.90	19.4	....	None

Lithia mine

Other names .... Ringling, Golden Slipper, Silver Slipper.
Location .... Sec. 31 (?) T. 12 N., R. 34 E.
Ownership .... Charles Milan (1957).
Antimony production .... 3.8 tons (metal).
Base map .... USGS Hawthorne 1° topographic quadrangle.

The Lithia mine is 16 miles east of Rawhide, almost on the Mineral-Nye County line. In 1956, 10 tons of ore containing 38 percent antimony were shipped to the Triangle Steel Co., of Los Angeles.

Two veins occur on the property. The southernmost has been developed by a 20-foot shaft. The northern one has been developed by a 25-foot adit with a 21-foot winze, a 12-foot crosscut, and a 32-foot drift (fig. 35).

Gray, medium-grained diorite crops out at the mine. It has a granitic texture, and is composed of 50 percent andesine, 10 percent orthoclase, 20 percent hornblende, 10 percent augite, 4 percent biotite, and 1 percent apatite. The diorite has been argillized along the veins, but is fresh elsewhere.

The southern vein strikes N. 75° E. and dips 85° S.; it is 24 to 30 inches wide and consists of gouge with 4 inches of quartz containing stibnite and antimony oxides. A representative sample of this quartz-antimony stringer assayed 2.3 percent antimony, but was barren of gold and silver.

The northern vein strikes N. 60° E. and dips 85° S.; it consists of 12 to 24 inches of gouge, 4 to 8 inches of quartz with ½ to 2 inches of stibnite and antimony oxides, and 2 inches of clay along the hanging wall. A small amount of stibnite and antimony oxides also occurs as stringers in the wall rock. A grab sample from the stockpile of vein material from this vein assayed 1.4 percent antimony but no gold, silver, selenium, or copper.

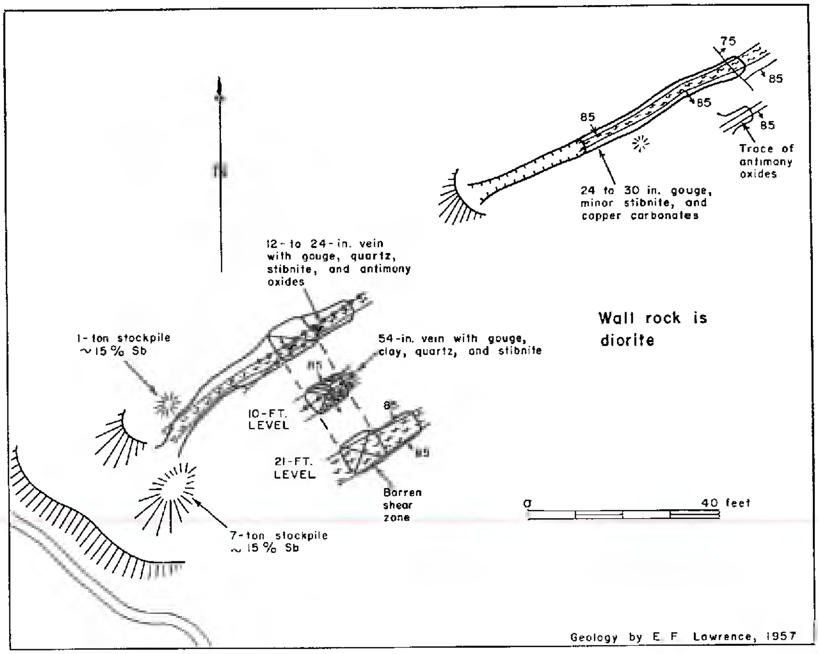

FIGURE 35. Geologic map of the Lithia mine, Mineral County, Nevada.

Stibnite occurs as single crystals, blebs, pods composed of bladed aggregates, and ½- to 2-inch veinlets in the quartz. Fibrous, white antimony oxide is present as pseudomorphs after stibnite. The yellow antimony oxide is powdery to vitreous. Reddish-orange antimony oxysulfide is common along fractures and cleavage planes in the vein material. Some green antimony oxides and malachite also are present.

Lucky Boy mine

Location — Secs. 17 and 18, T. 7 N., R. 30 E.
Ownership — June Babcock (1958).
Antimony production — None.
Base map — USGS Powell Mountain 15′ topographic quadrangle.

The Lucky Boy mine is in the Hawthorne mining district along the Lucky Boy Pass road on the west flank of the Wassuk Mountains.

Couch and Carpenter (1943, p. 105) reported that 3,049 tons of ore, valued at $76,913, were shipped. Values were in silver, gold, and lead. In 1958, the mine was owned by June Babcock of Hawthorne.

The mine has extensive workings (fig. 36). Three main shafts include the Hubbard shaft over 1,500 feet deep and inclined 70°; the Woodward shaft 470 feet deep and inclined 70°; and the vertical Spencer shaft 450 feet deep. The main (Miller) adit, 6,700 feet long, connects with all three of the shafts. Its connection with the Hubbard shaft lies on the 1,400-foot level. The Miller adit is caved at 3,200 feet. A 400-foot adit connects with the Hubbard shaft on the 150-foot level.

A vein 1 to 8 feet in width strikes N. 75°–85° E., dips 70°–85° S., and follows the intrusive contact between limestone and granodiorite. The ore occurs in lenses raking steeply westward. A skarn zone containing considerable scheelite, epidote, garnet, and hornblende occurs in the limestone along the contact.

The ore shoots contain tetrahedrite, chalcopyrite, galena, azurite, and malachite in quartz, minor calcite, and barite. An ore shoot in the Miller adit within 100 feet of the west end, near the Hubbard shaft, contained 30 percent antimony (White, unpublished data, U. S. Geol. Survey). During this examination, no antimony minerals other than tetrahedrite were observed in the mine or on the dumps. The following table lists the antimony and other values found in three ore samples taken from this mine.

No.	Description	Au oz.	Ag oz.	Sb %	Pb %	Cu %	Zn %
154	Grab sample, dump, Hubbard shaft	None	169.94	0.9	6.8	0.9	5.0
166	Grab sample, dump, Miller adit	None	34.34	0.7	Tr.	......	......
167	Vein, 100 feet from Hubbard shaft on 100-foot level, high-grade	None	275.98	1.1	......	......	......

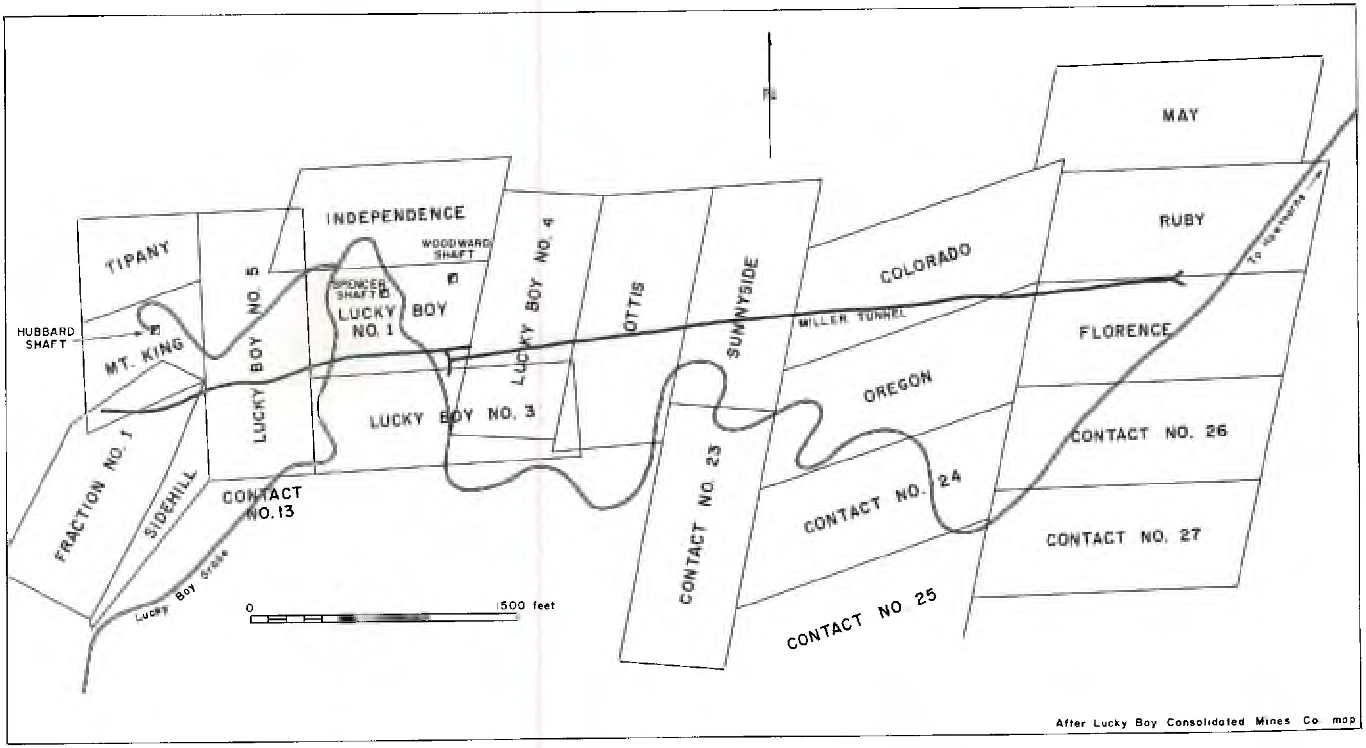

FIGURE 36. Claim map of the Lucky Boy mine, Mineral County, Nevada.

Volcanic Peak mine

Other names..........Bigongiari, Smith, Evening Star, Shay (?).
Location..........Sec. 33, T. 8 N., R. 35 E.
Antimony production..........5 tons (metal).
Base map..........USGS Hawthorne 1° topographic quadrangle.

The Volcanic Peak mine is in the Santa Fe mining district in Iron Gate Canyon on the east flank of the Gabbs Valley Range.

In 1883, Burchard reported the presence of antimony on Volcanic Peak (Hill, 1915, p. 163). Subsequent to the location of the mine in 1917, ten tons of antimony ore were produced. In 1940, three tons of ore containing 48 percent antimony were produced; in 1942, an additional ton which assayed 29 percent antimony was shipped. The showings are developed by two trenches and a 15-foot adit.

Gray to black crystalline limestone of the Triassic Luning Formation strikes N. 10° W. and dips 10° E. at the mine. In the canyon below, the limestone has been intruded by a quartz-monzonite plug.

The trenches expose one vein of silicified limestone 24 to 60 inches in width which strikes N. 65° E. and dips 85° N., and a second vein which strikes N. 70° E. and dips 50° N. Both veins contain some quartz and calcite. The quartz is vuggy, the vugs being lined with quartz crystals. Stibnite occurs as small pods, blebs, single crystals, and bladed aggregates partially replaced by white and yellow antimony oxides. The white oxide is fibrous. The yellow oxide is powdery where it occurs as coatings along fractures, and earthy to vitreous where it replaces stibnite. Pseudomorphs of limonite after pyrite commonly are associated with the pyrite. The adit exposes a vein 4 to 12 inches in width which strikes N. 65° E. and dips 85° S. This is barren of antimony minerals.

The following table shows the antimony and other values found in two ore samples:

No.	Description	Sb %	Au oz.	Ag oz.	Pb %	Zn %	Cu %
1	Grab sample, stockpile	25.53	None	2.20	0.1	0.1	0.01
2	Vein, bottom of trench	7.22	Tr.	0.25	0.1	0.2	0.01

NYE COUNTY

Hot Creek Range

The Hot Creek Range in north-central Nye County extends northward from Warm Springs, on the Tonopah-Ely highway

50 miles east of Tonopah. The range is made up of Paleozoic sediments, overlain by Tertiary volcanics. Ferguson (1933) has described the area near Tybo.

Lucky Tramp prospect

Other names	Antimony Queen, Lucky Vagabond, Morning Glory, Yellow Rock.
Location	Sec. 22(?), T. 5 N., R. 49 E.
Ownership	Magnus F. and Lorina Peterson (1959).
Antimony production	Small.
Base map	U. S. 1: 250,000 scale topographic map, Tonopah sheet.

The Lucky Tramp prospect is in the Tybo mining district, 2½ miles north of the M & M and A & B mines. It is developed by four open cuts and a 15-foot shaft (fig. 37).

Tertiary rhyolite tuff, containing fragments of quartz and argillized feldspar up to one-fourth of an inch across, crops out at the prospect. A vein 1 to 6 inches in width with sporadic quartz strikes N. 50°–70° W. and dips 75°–85° NE. Partially altered stibnite is present as pods up to 8 inches across, veinlets up to 2 inches wide, bladed aggregates up to 3 inches across, radiating clusters, rosettes, blebs, and single crystals. A grab sample from a small stockpile ran 32.09 percent antimony, trace of selenium, and no gold or silver.

Fibrous to subvitreous white antimony oxide commonly shows residual cores of stibnite. Powdery to earthy, yellow oxide coats stibnite, quartz, and wall rock next to the veins. The yellow oxide occurs as vitreous masses in vugs. Red oxysulfide (kermesite?) fills cleavage planes and fractures.

The wall rock has been silicified for a few inches outward from the vein.

Morey mine

The Morey mine is in T. 9 N., R. 51 E., approximately 3 miles north of Morey Peak, about 5 miles southwest of Moore's Station (see U. S. 1: 250,000 scale topographic map, Tonopah sheet). From 1865 to 1940 the mine produced $462,972 worth of silver, gold, and lead (Couch and Carpenter, 1943, p. 113) with the main values in silver. No antimony ore as such has been shipped.

Kral (1951, p. 132) has described the geology in some detail. The mine is in porphyritic quartz latite. Minerals present include rhodochrosite, sphalerite, pyrargyrite, stephanite, pyrite, and andorite.

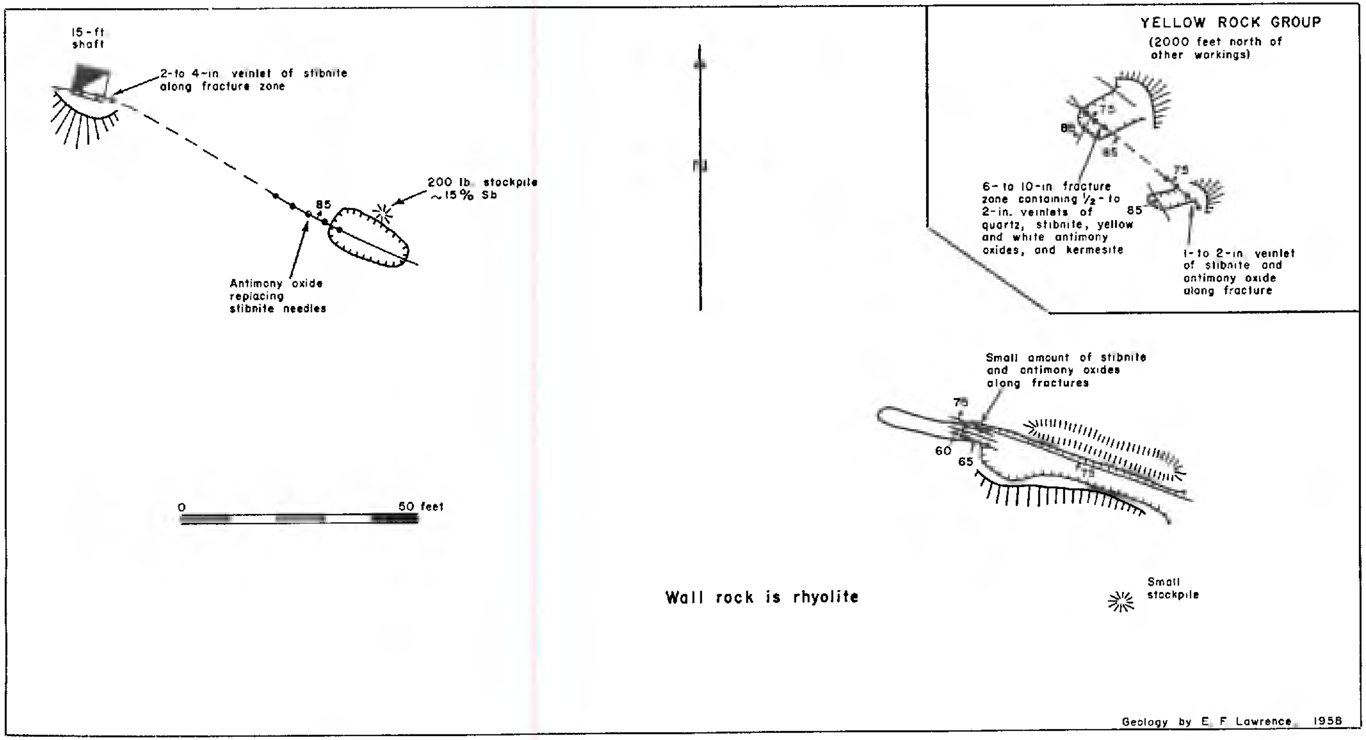

FIGURE 37. Geologic map of the Lucky Tramp prospect, Nye County, Nevada.

Outlook prospect

The Outlook prospect is in the Tybo mining district in the saddle at the head of Keystone Canyon on a southeast spur of Sine Mountain, 3 miles northwest of Tybo in T. 6 N., R. 50(?) E. (U. S. 1:250,000 scale topographic map, Tonopah sheet). The prospect is owned by C. A. MacDowell. Only a few pits have been dug.

The country rock is gray, massive limestone which is intruded by a dike which crops out in the saddle. Brown-stained quartz fills fractures in the limestone. Single crystals and radiating clusters (up to 1 inch across) of stibnite, scattered through the limestone, commonly are partially altered to yellow and fibrous white antimony oxides.

Page mine

Other names	Hot Creek, Clifford-Lisota, Dugan, Predmoness, Wilcox, King.
Location	Secs. 15, 16, 21, 22, T. 8 N., R. 49 E.
Ownership	Joe Clifford.
Antimony production	23 tons (metal).
Base map	U. S. 1:250,000 scale topographic map, Tonopah sheet.

The Page mine is in the Hot Creek mining district, 7.4 miles upstream from the Hot Creek Ranch.

In 1916, 28 tons of ore averaging 50 percent antimony were shipped. Development consists of about 700 feet of trenches and open cuts, and three shafts, the deepest of which is 60 feet.

Tertiary rhyolite flows and tuffs crop out at the mine. The flows are gray and porphyritic, with phenocrysts of albite, quartz, biotite, and hornblende making up some 30 percent of the rock.

The main vein, striking N. 45° E. and dipping 70°–85° NW., is 1 to 24 inches wide and more than 1,000 feet in length (pl. 7). It is composed principally of quartz and stibnite. The latter occurs as blebs, bladed aggregates forming small pods, radiating clusters, single crystals, and veinlets in quartz and the adjacent rhyolite. Small pods up to 4 inches across are locally abundant enough to form mineable lenses. Quartz commonly is fine grained and vuggy. The stibnite is partially altered to yellow and white antimony oxides. Red oxysulfide (kermesite?) occurs along cleavages and fractures; with continued oxidation it apparently alters to fibrous, white antimony oxide. Powdery to vitreous, yellow antimony oxide occurs as pseudomorphs after stibnite and as stains on the white oxide and wall rock.

Along the veins, the phenocrysts in the rhyolite are kaolinized (?) while the groundmass is silicified and argillized.

Two ore samples taken from this mine were analysed for antimony, selenium, gold, and silver. The results of these analyses are given below:

No.	Description	Sb %	Au oz.	Ag oz.	Se %
174	Grab sample, stockpile	16.53	None	0.76	0.01
175	2-inch vein	39.36	None	0.26	None

Titus prospect

The Titus prospect is in T. 10 N., R. 52 E., approximately 7 miles northeast of Moore's Station (see U. S. 1:250,000 scale topographic map, Tonopah sheet). The only development is two prospect pits.

The prospect is in limestone which strikes N. 35° E. A shear zone, N. 35° E., up to 80 feet wide cuts the limestone. A parallel fault, dipping 70° SE., is exposed by a shallow prospect pit along the west side of the wash. This fault contains several small pods and radiating clusters of stibnite. Individual crystals in the clusters are up to 6 inches long. A smaller amount of stibnite occurs along the wash in brecciated and partially silicified limestone.

Reveille Range

The Reveille district is in the Reveille Range approximately 25 miles southeast of Warm Springs, on the Tonopah-Ely highway. It has produced $610,982 in silver, lead, copper, and gold (Couch and Carpenter, 1943, p. 114). Rocks in the area include Paleozoic limestone and quartzite, overlain by Tertiary rhyolite. Most of the deposits are in the quartzite, but a few, on the west side of the district, are in limestone. Rhyolite and latite dikes are common. The principal ore minerals have been cerargyrite, cerussite, galena, malachite, azurite, pyrargyrite, argentite, and stibnite.

Antimonial mine

Other names........ Silvermonial, Steele, Peterson, Bates, Reveille, Craig, Buchley, Black Hawk.
Location........ T. 2 N., R. 51 E.
Ownership........ Magnus Peterson, E. M. Booth, and Lee Hand (1961).
Antimony production........ 29 tons (metal).
Base map........ U. S. 1:250,000 scale topographic map, Tonopah sheet.

The Antimonial mine is in the Reveille mining district 1 mile

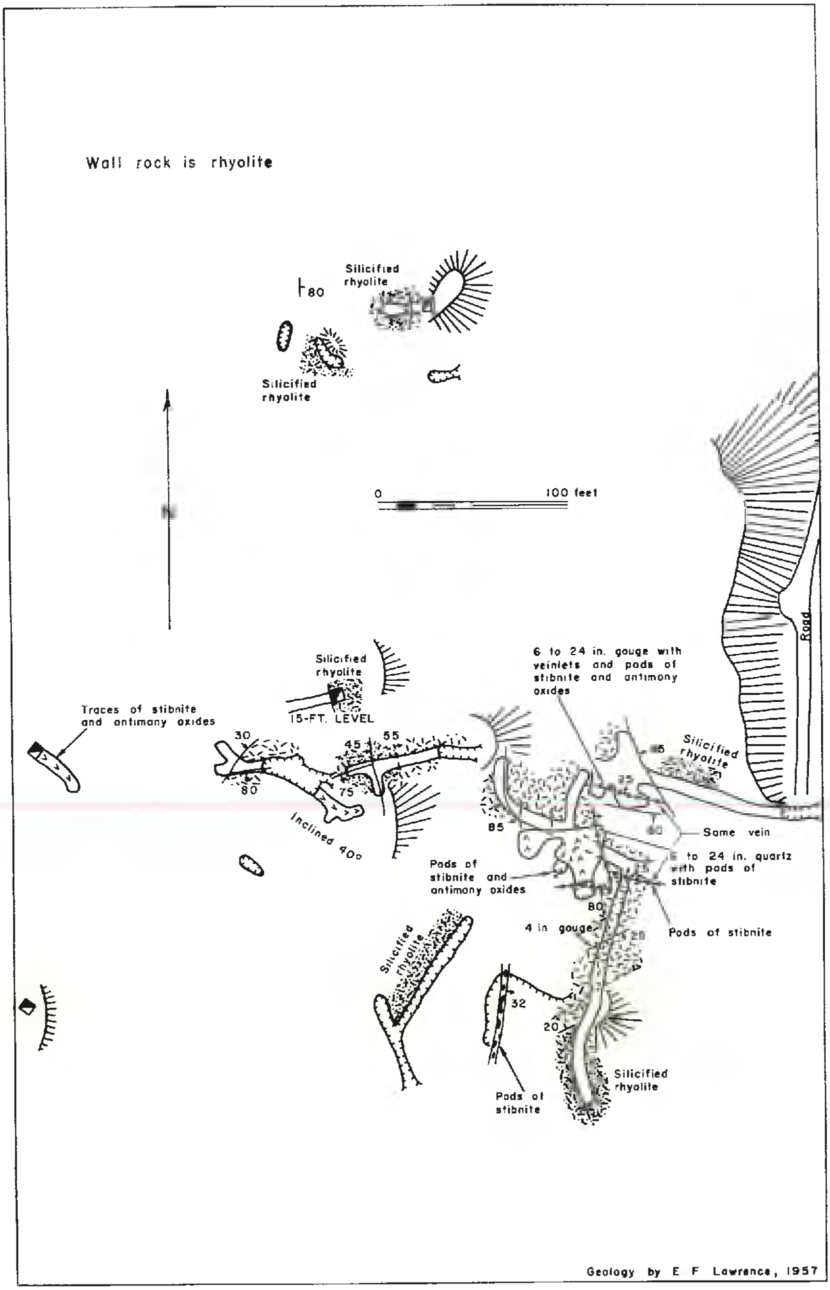

FIGURE 38. Geologic map of the Antimonial mine, Nye County, Nevada.

west of the old Reveille townsite on the north slope of the Reveille Range.

An oxide plant was built in 1937 and put into operation in 1938. Eleven tons of concentrates assaying 76 percent antimony were produced in 1939; seven tons assaying 78 percent antimony in 1940; six tons of ore assaying 60 percent antimony in 1940; and 37 tons assaying 32 percent antimony in 1941.

The mine is developed by three vertical shafts with depths of 15, 40, and 45 feet, a 30-foot inclined (45°) shaft, a 40-foot inclined (35°) shaft, a 22-foot inclined (40°) shaft, five adits totaling 522 feet, and numerous open cuts and pits (fig. 38).

Tertiary rhyolite porphyry overlies Paleozoic quartzite at the mine. The rhyolite is commonly highly silicified and contains relict flow structures resembling gray, banded chert.

The main vein strikes N. 80° W., dips 20°–25° N., and is intersected by another vein which strikes N. 5°–15° W. and dips 30°–45° E. Several other small veins occur higher up the hillside. The main vein, composed mainly of quartz and gouge, is 2 to 24 inches wide. The north-trending vein is 6 to 24 inches wide.

The quartz and silicified rhyolite are vuggy. Vugs in the quartz are lined with stubby quartz crystals and hairlike tufts of stibnite. This sulfide also occurs as blebs, small pods, radiating clusters, bladed aggregates, and single crystals. Near the rhyolite-quartzite contact, the pods are abundant enough to form mineable lenses. Pyrite is relatively common in the veins.

Red oxysulfide occurs along cleavage planes and in fractures. It commonly is replaced by powdery to earthy, yellow antimony oxide. The yellow oxide also is present as vitreous crystals and hairlike tufts that are pseudomorphs after stibnite. Phenocrysts in the rhyolite are argillized, while the groundmass is silicified.

The analyses of two samples from this mine are shown in the table below:

No.	Description	Sb %	Au oz.	Ag oz.	Se %
172	24-inch vein	37.12	Tr.	0.58	0.014
173	6-inch vein	27.0	None	33.48	None

Eaton prospect

The Eaton prospect is in T. 2 N., R. 51½ E. in the Arrowhead mining district, approximately 2 miles northwest of Reveille (see U. S. 1:250,000 scale topographic map, Tonopah sheet).

In 1939, 15 tons of ore containing 20 percent antimony were produced. Paleozoic quartzite and limestone are capped by andesite and rhyolite. The ore is pyrargyrite, argentite, and stibnite.

Southern Toiyabe Range

The geology of the southern end of the Toiyabe Range in northern Nye County has been described by Ferguson and Cathcart (1954). On the east flank of the range, Cambrian, Ordovician, Devonian, Permian, Triassic and Jurassic sediments and volcanics crop out. These are overlain by Tertiary volcanics and pyroclastics. The Paleozoic rocks have been intruded by numerous stocks, dikes, and sills of granodiorite, granite, quartz, monzonite, diorite, porphyry, aplite, and diabase. The antimony mineralization occurs in the Paleozoic sediments, and is spatially associated with Jurassic intrusives, although genetically it could be associated with either Jurassic or Tertiary igneous activity.

Dollar mine

Other names..........Schapal, Silver Top.
Location..........Secs. 14 and 15(?), T. 9 N., R. 42 E.
Ownership..........Herman Schapal (1957).
Antimony production..........None.
Base map..........U. S. 1:250,000 scale topographic map, Tonopah sheet.

The Dollar mine is in the Jett district on the south side of Boyd Canyon, 0.2 miles from its mouth, and along the eastern flank of the Toiyabe Range.

The mine is developed by three adits, totaling over 400 feet and by a 30-foot inclined (45°) shaft (fig. 39).

Ordovician schist, slate, shale, and limestone have been intruded by a dike. The black, carbonaceous and calcareous shale strikes N. 70°–85° W. and dips 70° SW. At the northern adit, the schist strikes N. 35° W. and dips 85° N. The main vein, striking N. 55° W. and dipping 75°–80° NE., is offset by several north-trending faults. The vein is up to 18 inches wide and consists of gouge and quartz. Stibnite is granular, equidimensional, and medium grained; it occurs as blebs, small pods up to 3 inches across, and single crystals. Pyrite is scattered sporadically through the vein and adjacent wall rock. Pyrite and stibnite apparently were deposited simultaneously. Grains of tetrahedrite are scattered through the veins. Malachite and azurite occur along fractures. Powdery to vitreous, yellow antimony oxide coats stibnite and quartz, as well as replacing stibnite. The following table gives the results of an assay of two ore samples from this mine:

No.	Description	Sb %	Au oz.	Ag oz.
200	14-inch vein, inclined shaft	0.6	None	None
201	Grab sample, ore in drum	40.63	None	None

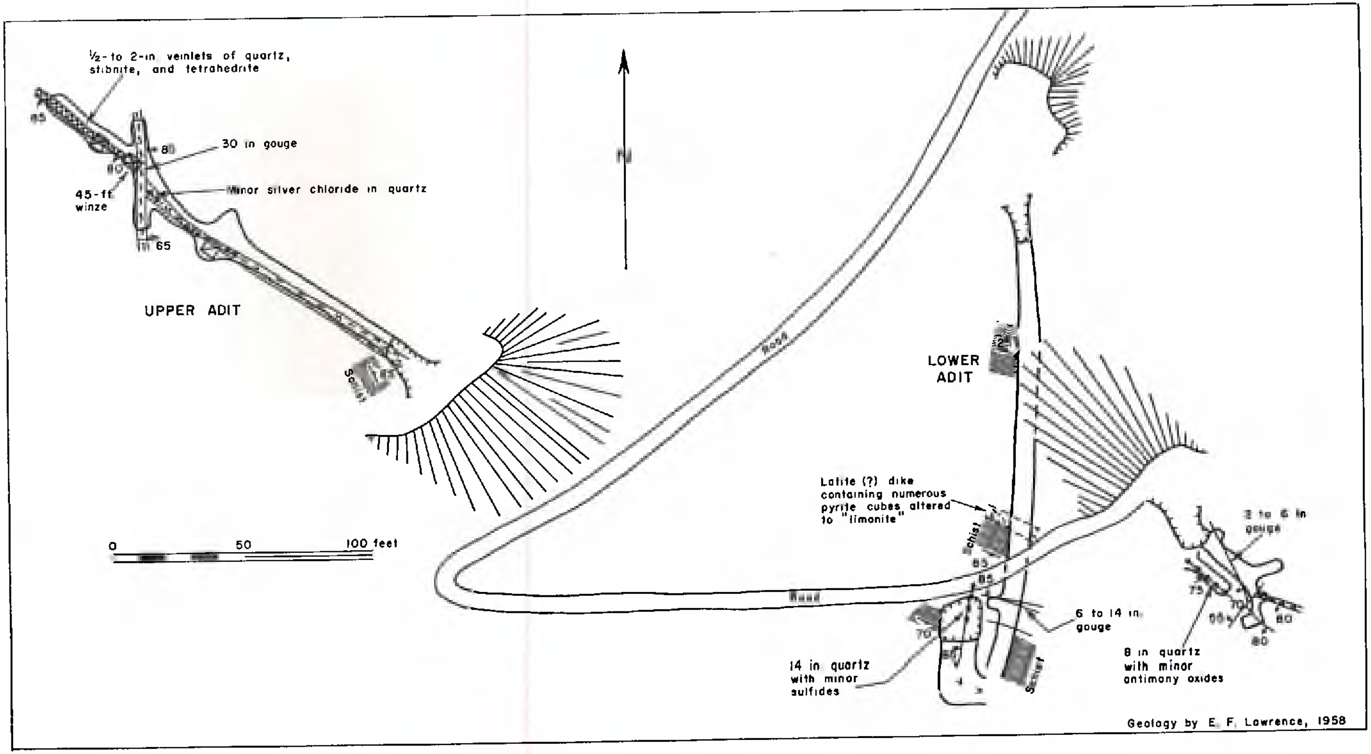

FIGURE 39. Geologic map of the Dollar mine, Nye County, Nevada.

Last Chance mine

Other names	Silver Divide, Bastian, Wall Canyon, Herd, Francisco (?).
Location	Sec. 17 (?), T. 10 N., R. 42 E.
Ownership	Great Western Mining Co. (1958).
Antimony production	192 tons (metal).
Base map	U. S. 1:250,000 scale topographic map, Tonopah sheet.

The Last Chance mine is in the Jett district on the divide between Wall Canyon and San Pablo Canyon on the east flank of the Toiyabe Range.

The mine was originally located in 1915. Four hundred tons of ore containing an average of 20 percent antimony were reportedly shipped during World War I. Several sources indicate that 14 tons of ore containing an average of 60 percent antimony, and 29 tons averaging 45 percent antimony were shipped in 1939; and that seven tons of 34 percent antimony ore were shipped in 1940. During 1941 and 1942, 214 tons of 10 percent antimony ore and 30 tons of 30 percent ore were shipped by Antimony Producers Co. The property was leased to the Last Chance Mining Co. in 1947, and a 50-ton flotation mill and a small furnace were built, but operations were suspended in 1953 with no reported production of additional ore. The mine was leased to the Great Western Mining Co. in 1955. The last reported production (1957–58) consisted of 29 tons of ore averaging 15 percent antimony, and 15 tons of ore containing 11 percent antimony.

The mine is developed by a 180-foot shaft with a total of 300 feet of drifting on the 60-, 80-, 96-, 126-, and 175-foot levels. An adit connects with the 126-foot level. Other workings elsewhere on the property include a 180-foot adit above the shaft, several open pits, and short adits (pl. 8).

At the mine, highly contorted thin-bedded Permian (?) limestone and black shale have been intruded by several rhyolite porphyry dikes, the largest of which is 150 feet wide. The sedimentary rocks strike N. 5°–35° W. and dip 40°–70° W. Wall rock along the veins most commonly is black carbonaceous shale.

The main vein, which strikes N. 70° E. and dips 45°–55° NW, and also two other veins, are shown in the plate. The westernmost vein cuts and offsets a nonmineralized vein which strikes N. 80° W. and dips 60°–80° to the north. In the area around the main shaft are numerous faults containing up to 6 inches of gouge.

The veins consist principally of brecciated wall rock, gouge, and sporadic quartz and calcite. Stibnite occurs in the veins as blebs, small pods up to 4 inches across, veinlets, radiating clusters, and single crystals. Stibnite in the pods most commonly is fine grained and granular. Pyrite, minor tetrahedrite, and malachite are associated with the stibnite. The higher grade ore came from the main vein near the shaft.

Rhyolite near the veins has been chloritized and the groundmass flooded by carbonate; the shale and limestone have been partially silicified.

Stibnite commonly is partially altered to antimony oxides. The yellow oxide is abundant, occurring as powdery to earthy masses, and as pseudomorphs after needles of stibnite. Only a small amount of white oxide is present. Four ore samples from this mine were analyzed; the results are given in the table shown below.

No.	Description	Sb %	Au oz.	Ag oz.	Se %
207	Grab sample, dump	35.50	0.02	0.90	0.005
208	Grab sample, ore bin	4.15	Tr.	None	0.005
209	Grab sample, dump	5.49	None	None	0.005
221	8-inch vein	9.88	Tr.	None	0.005

Murphy mine

Other names............Ophir.
Location............Sec. 31, T. 13 N., R. 42 E.
Ownership............Goldie Lastreta (1951).
Antimony production...... None.
Base map............U. S. 1: 250,000 scale topographic map, Tonopah sheet.

The Murphy mine is in the Twin River district in Ophir Canyon, on the east slope of the Toiyabe Range. The mine has produced approximately $760,000 worth of gold and silver, mostly prior to 1890. It is developed by a 360-foot inclined (45°) shaft with 2,000 feet of workings. The shaft is near the creek level, and is flooded (1957). All the workings were driven northward beneath the hill. Here, the vein was cut off by a fault, but no continuation of it could be found to the north.

Hague (1870, p. 384) reported that tetrahedrite, stibnite, pyrargyrite, galena, sphalerite, native silver, gold, and pyrite are the principal ore minerals. Only a few traces of these minerals could be found on the dump during this study.

Teichert mine

The Teichert (Antimony, Fredrick C., Lead King) mine is in the Twin River mining district in sec. 15(?) T. 12 N., R. 42 E., in the North Twin River Canyon on the eastern slope of the

Toiyabe Range. Workings consist of two adits, two shafts, and winze (fig. 40). There has been no recorded production from this mine.

The country rock is granodiorite intruded by a fine-grained diabase dike (Ferguson and Cathcart, 1954). Near the dike the granodiorite is high in orthoclase and is of granitic composition. It is composed of 65 percent orthoclase, 30 percent quartz, 2 percent albite, and 2 percent biotite. The main vein seen at the

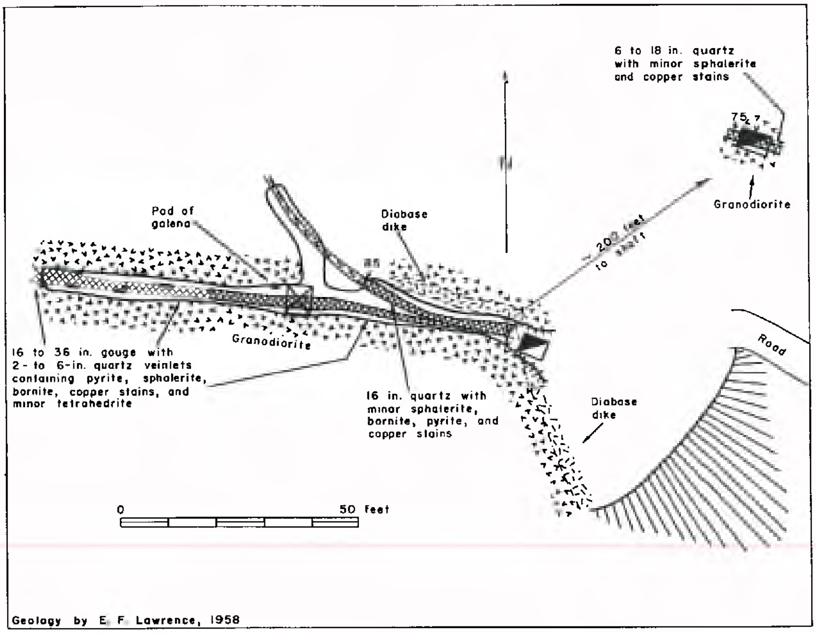

FIGURE 40. Geologic map of the Teichert mine, Nye County, Nevada.

entrance to the southwestern adit, strikes N. 85° W. and has a vertical dip. A few feet from the entrance the vein splits, and a minor offshoot strikes N. 45° W. and dips 85° SW. In the northeastern shaft, another vein strikes N. 70° W. and dips 75° NE. The ore minerals in the main vein are galena, pyrite, bornite, sphalerite, and minor tetrahedrite. Traces of yellow antimony oxide were noted on the dump. A grab sample of ore assayed 0.10 ounces of gold and 6.9 ounces of silver per ton, 31.3 percent antimony, trace of selenium, 4.4 percent lead, 10.1 percent zinc, and trace of copper.

Toquima Range

The part of the Toquima Range extending from Manhattan to a few miles north of Round Mountain has been described by Ferguson and Cathcart (1954). The gold-arsenic-antimony-mercury mineralization at Manhattan occurs in the Gold Hill Formation of Cambrian Age. The Belmont area is underlain by Ordovician shale and limestone, which contain quartz veins carrying antimonial silver ores, including stetefeldite. Granitic rocks of Jurassic(?) Age are common around each of these areas, but Ferguson (1924, p. 116) believed that the mineralization is genetically related to Tertiary volcanics. Ferguson's hypothesis is based on correlation of the mineralization with that at Round Mountain, which is clearly associated with Tertiary intrusives. Dynan (private report, 1934) believes the mineralization at the White Caps mine in the Manhattan district is genetically related to the granitic intrusion.

Antimony Lode prospect

Other names	Jefferson Canyon, Henebergh.
Location	Sec. 13(?), T. 10 N., R. 44 E.
Ownership	John A. Henebergh and Edward H. Michol.
Antimony production	1 ton (metal).
Base map	U. S. 1:250,000 scale topographic map, Tonopah sheet.

The Antimony Lode prospect is in the Jefferson mining district in Davenport Canyon, half a mile above its intersection with Jefferson Canyon, 4 miles east of Round Mountain. This probably is the same occurrence mentioned by Kral (1951, p. 81) as being in the Jefferson Canyon mining district.

A shipment of antimony ore was made in 1957 (Ted Stevens, oral communication, 1958). The prospect has been developed by a shallow vertical shaft (caved) and a 45-foot inclined (25°) shaft (filled with water).

The mine is in an area of shale, shaly limestone, and limestone of Paleozoic Age, probably the Ordovician Palmetto Formation (Ferguson and Cathcart, 1954). A 6- to 10-foot silicified zone, striking N. 30° W. and dipping 45°–70° W., cuts black, carbonaceous shale. The shale in this zone is brecciated and completely silicified.

A quartz vein up to 6 inches wide follows the footwall of the silicified zone. This vein contains stringers up to three-fourths of an inch wide and pods up to 12 inches across of stibnite. This sulfide also occurs as blebs, small pods, and single crystals replacing the calcareous shale in the footwall. Stibnite has been partially oxidized to yellow and white antimony oxide. The yellow oxide is powdery to vitreous, and in places replaces pods of stibnite. White antimony oxide occurs along fractures as pseudomorphs after needles of stibnite. Antimony and other values found in two samples of ore from this mine are shown in the table below:

No.	Description	Au oz.	Ag oz.	Sb %	As %	Pb %
199	Grab sample, stockpile	None	0.06	8.17	....	....
199A	Grab sample, stockpile	....	....	61.1	0.13	0.13

Flower mine

Other names............ Fiorite, Logan, Bar, Duane group, Kernick Divide Mining Co., Kernick-Duane.
Location............ Sec. 33 (?), T. 10 N., R. 45 E.
Ownership............ Frank Warren (1958).
Antimony production...... None.
Base map............ U. S. 1:250,000 scale topographic map, Tonopah sheet.

The Flower mine is in the Belmont mining district on the east flank of the Toquima Range in Antone Canyon, 1½ miles south of its intersection with Meadow Creek.

To the end of 1943, quicksilver production has been about 50 flasks (Bailey and Phoenix, 1944, p. 135).

The mine has been developed by several hundred feet of underground workings in the mercury area, and by two adits in the antimony area a few hundred feet to the north (fig. 41). The upper adit in the antimony area extends 12 feet into the wall of an open cut; the lower adit is 150 feet long.

Quartzite, phyllite, and limestone have been intruded by granite and are overlain by rhyolite tuff. Gray to brown shale, which strikes N. 10°–30° W. and dips 25°–85° W., crops out in the antimony area. Here, the main shear zone, which strikes N. 10° W. and dips 85° W., intersects a vein that strikes N. 30° W. and dips 75° E. Quartz veinlets up to 16 inches wide occur sporadically in the shear zone. The shale along the vein is silicified.

Stibnite occurs as bladed aggregates forming pods up to 14 inches across, as radiating clusters, as blebs, and as single crystals

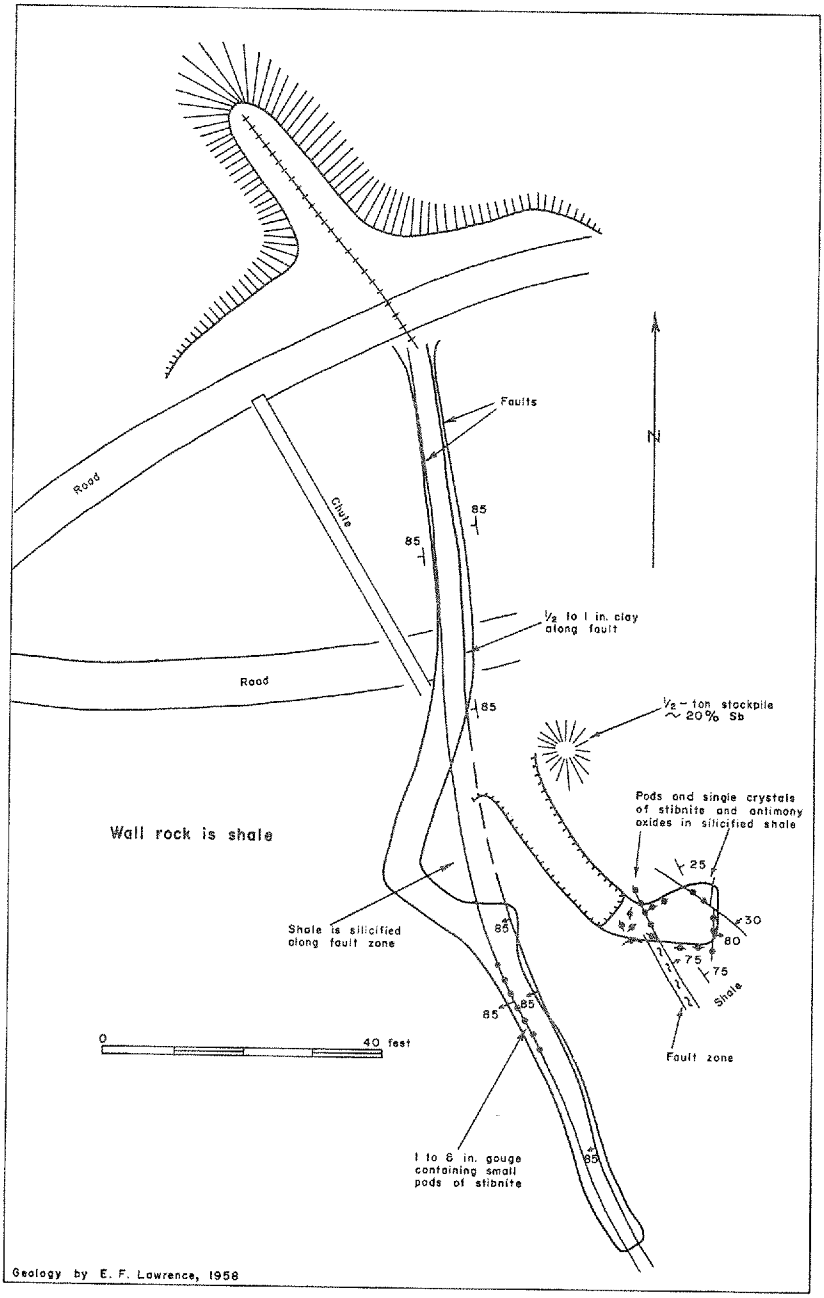

FIGURE 41. Geologic map of the Flower mine, Nye County, Nevada.

in quartz. The pods average 4 to 6 inches across and are concentrated in lenses at the intersection of the vein and shear zone.

Some cinnabar occurs with the stibnite in the antimony area, and a small amount of stibnite has been found in the mercury area to the south. In these limited occurrences the cinnabar and stibnite are closely associated and appear to have been deposited simultaneously.

Yellow antimony oxide occurs as vitreous, earthy, and powdery coatings on quartz, stibnite, and white antimony oxide. The white oxide commonly is fibrous, and occurs as pseudomorphs after stibnite.

A grab sample of ore from the stockpile at the upper workings assayed 18.60 percent antimony, a trace of selenium, and no gold or silver.

Spanish Gap

According to Hess (unpublished data, U. S. Geol. Survey), Ferguson reported the occurrence of stibnite at the old mining camp of Spanish Gap, between Belmont and Round Mountain. However, Ferguson later denied this as an unfounded report.

White Caps mine

Location	Sec. 29, T. 8 N., R. 44 E.
Ownership	White Caps Gold Mining Co.
Antimony production	50 tons (metal).
Base map	U. S. 1:250,000 scale topographic map, Tonopah sheet.

The White Caps gold mine is in the Manhattan district in Consolidated Gulch on the west flank of the Toquima Range, 1¼ miles east-southeast of Manhattan. Over $2.5 million worth of gold has been produced. Located as a gold mine in 1905, the property produced its first ore in 1911.

In 1915, the White Caps Mining Co. was organized and a new 100-ton mill was built. In 1925, 83 tons of ore averaging 22 percent antimony were shipped; from 1920 to 1933, shipments were made to the Tacoma smelter. In 1936, 33 tons of ore assaying 33 percent antimony were shipped; 11 tons averaging 31 percent antimony were shipped in 1940. After a period of inactivity, the mine was reopened and in 1957 some mining was done on the 300- and 500-foot levels. In 1958, 15 tons of ore averaging 40 percent antimony were shipped to Morris Kirk, of Los Angeles, and 20 tons were shipped to the Big Creek Mining and Milling Co., in Austin, Nevada.

The mine is developed by a 900-foot shaft with extensive workings on the 310-, 565-, and 800-foot levels, and by a 500-foot inclined winze on the 800-foot level with less extensive workings on the 900-, 1,100-, 1,200-, and 1,300-foot levels, as well as several small shafts, open cuts, and trenches (pl. 9).

The geology of the mine has been described by Ferguson (1924) and Dynan (private report, 1934).

Ferguson (1924, p. 97–108) stated that all of the stibnite ore occurred within the White Caps Limestone Member of the Gold Hill Formation, which was cut by four major faults and many minor faults. He found that the fault blocks are wedge-shaped because of the apparent merging of the Morning Glory, West, and White Caps faults in the southeastern part of the workings. It appeared that the minor faults were premineral, but that movement along the major faults had taken place subsequent to the major period of ore deposition. Ferguson found that mineralization occurs in two principal zones, one on each side of the White Caps fault (pl. 9). In a few places the ore and mineralized limestone occupy the entire thickness of the formation.

Stibnite has been found throughout the White Caps mine as radiating clusters (up to 4 inches across) replacing limestone and calcite, and in quartz vein material. Stibnite also is found as bladed aggregates in pods up to 36 inches across, with individual blades up to 3 inches across, and as blebs, single crystals, and clusters of euhedral needles in cavities in calcite and quartz. Unusually well developed stibnite crystals have been shipped as specimen material.

In the winze on the 300-foot west level, stibnite occurs in large mineable lenses. The shipments made in 1958 probably originated in this area. Stibnite is closely associated with realgar, orpiment, cinnabar, and high-grade gold. Realgar fills the interstices in the stibnite and occurs as crystals in vugs in limestone and in quartz. Cinnabar also occurs as blebs and single crystals, with stibnite, in a silicified zone, and commonly is surrounded by yellow powdery to earthy antimony oxide. Orpiment appears to be an alteration product of realgar.

Stibnite also occurs in the east ore shoot between the 300- and 500-foot levels, as euhedral crystals in clay and gouge, and as blebs, small pods, and lenses. Realgar, orpiment, pyrite, fluorite, and minor azurite are associated with the stibnite in this area. Stibnite also has been reported in the east ore shoot of the Manhattan Consolidated mine adjoining the White Caps mine on the west (Ferguson, 1924, p. 90).

On the surface east of the main shaft, at the top of the east ore shoot (fig. 42), stibnite occurs as bladed aggregates up to 4 inches across with individual blades up to 2 inches long, and as blebs and single crystals. The stibnite commonly replaces limestone, but less commonly is in quartz or in silicified limestone. The wall rock is sandy to crystalline limestone.

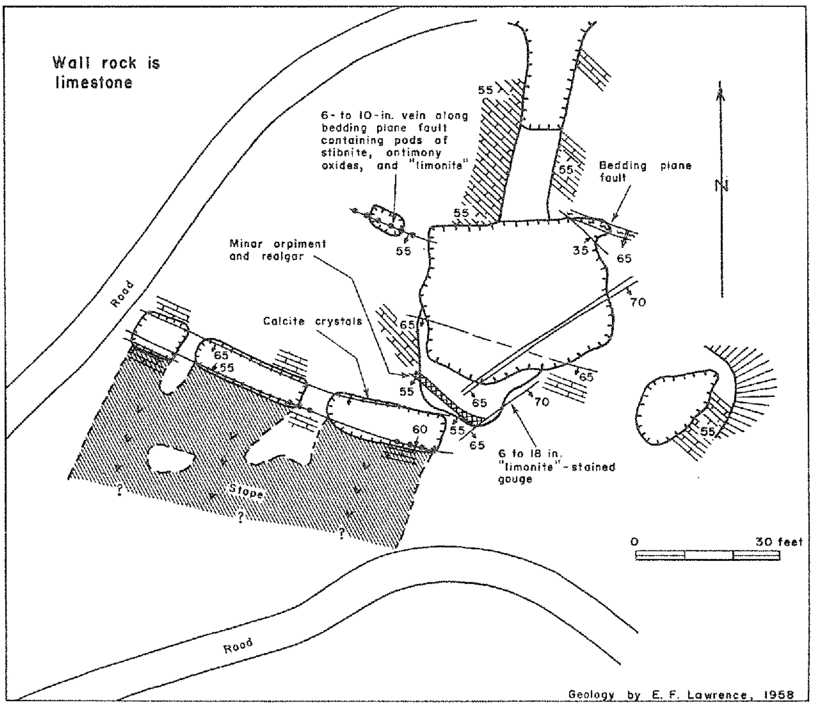

FIGURE 42. Map of part of the east ore shoot, White Caps mine, Nye County, Nevada.

Stibnite near the surface has been partially oxidized to dull-to-vitreous, and sometimes fibrous white antimony oxide. Yellow antimony oxide commonly stains the white oxide. On the 300- and 500-foot levels, red antimony oxysulfide occurs along cleavage planes and fractures. Powdery to earthy yellow oxide also is common as coatings along fractures.

The following table shows analyses of five ore samples taken from this mine.[1]

[1]Ferguson, 1924, p. 150.

	Ore Samples				
	1	2	3	4	5
Insoluble (SiO_2)	44.6	67.6	50.3	55.8	43
Al_2O_3	1.8	1.8	1.5	1.8	0.4
CaO	21.1	5.14	8.16	7.2	18
MgO	0.7	0.9	2.7	3.17	4
Fe	4.8	7.6	8.4	8.9	6.1
S	1.38	3.5	4	8.2	4.3
Sb	8.76	6.78	6.78	0.71	0.6
As	....	....	....	1.44	0.6
Mn	....	....	....	0.12	0.2
Balance largely CO_2					
	83.64	94.12	82.33	85.32	77.2

Other Occurrences in Nye County

Blackbird prospect

Other names............Tognoni, Strode, Silver King.
Location............T. 8 N., R. 54 E.
Ownership............Madison Locke (1958).
Antimony production......None.
Base map............U. S. 1:250,000 scale topographic map, Lund sheet.

The Blackbird prospect is in the Pancake Range, 1 mile north of the Silverton mine and U. S. Highway 6, about 5 miles northeast of Black Rock Summit, and approximately 6 miles west of Lockes Station.

The deposit is developed by seven shallow shafts and open cuts (fig. 43).

Extrusive rhyolite porphyry with phenocrysts of quartz up to half an inch in length crops out at the prospect. Flow banding in the rhyolite strikes N. 55° E. and dips 55°–65° NW. At the Silverton mine, this rock overlies Pennsylvanian (?) limestone.

The main vein, at places up to 16 inches in width, strikes N. 45°–65° E. and dips 55°–80° NW. To the south a second vein strikes N. 70° E. and dips 85° SE., and is up to 2 inches wide. The veins consist principally of brecciated and silicified rhyolite cemented by quartz. The quartz is vuggy, with drusy quartz lining the vugs. The rhyolite wall rock along the veins is silicified.

Stibnite occurs in the veins as blebs, small pods up to 3 inches across, veinlets, rosettes, and single crystals up to 1 inch long. The pods, veinlets, and rosettes most commonly are bladed, with individual blades up to 1 inch long. A few grains of pyrite are associated with the stibnite. Crystals of barite up to 2 inches across occur in the veins and enclose needles of stibnite.

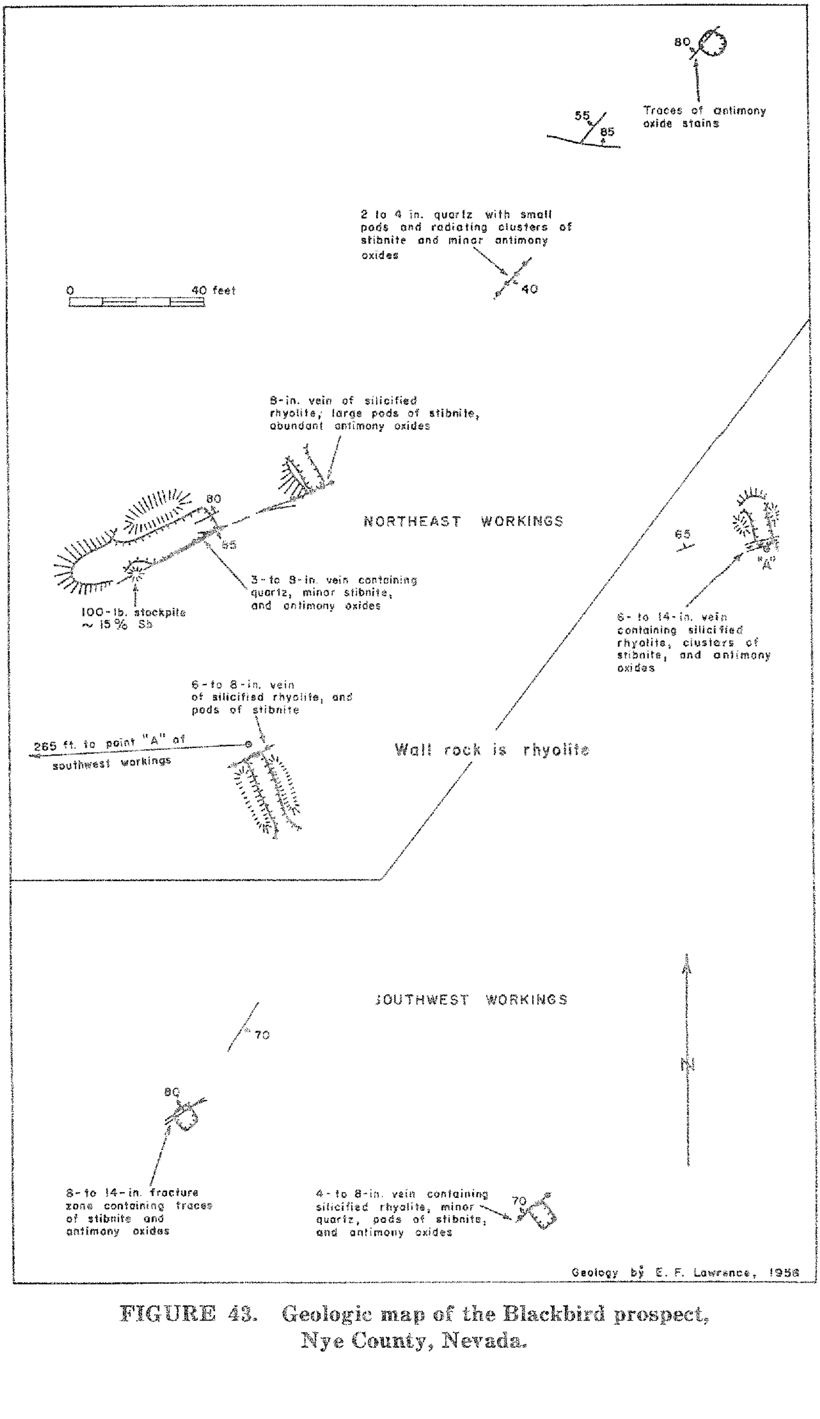

FIGURE 43. Geologic map of the Blackbird prospect, Nye County, Nevada.

The rhyolite porphyry has been completely argillized and silicified; the feldspar phenocrysts have been kaolinized (?), and near the veins, leached out.

Red antimony oxysulfide occurs along cleavage planes in the stibnite. Yellow antimony oxide occurs as powdery to earthy coatings along fractures and lining cavities from which feldspar phenocrysts have been leached, as pseudomorphs after stibnite in vugs, and as pseudomorphs after needles of stibnite enclosed in barite. Some white and yellowish-green antimony oxides also are present. Results of the analysis of four ore samples are given in the table below:

No.	Description	Sb %	Au oz.	Ag oz.	Se %
177	5-inch vein, top of shaft	12.59	None	0.16	0.040
178	4-inch vein, bottom of shaft	9.14	Tr.	None	....
205	6-inch vein	6.40	Tr.	0.10	None
206	8-inch vein	7.69	Tr.	0.72	0.005

Danville prospect

Stibnite is reported (Magnus Peterson, oral communication, 1958) in the Monitor Range in the Danville mining district, a few miles north of the King Solomon mine, but this prospect could not be found by the writer.

King Solomon mine

Other names..................Willow Creek, Peterson.
Location..................Secs. 25 and 36, T. 9 N., R. 47 E. and sec. 1, T. 8 N., R. 47½ E.
Ownership..................Magnus F. and Lorina Peterson (1959).
Antimony production..................Small.
Base map..................U. S. 1: 250,000 scale topographic map, Tonopah sheet.

The King Solomon mine is near the head of Willow Creek on the east flank of the Monitor Range.

Development consists of two inclined shafts with depths of 28 and 33 feet, and a number of open cuts and pits as shown in figure 44. Both shafts are inaccessible, the 28-foot shaft being filled with water. The remains of a volatilizing furnace can be seen.

Tertiary rhyolite tuff crops out at the mine; andesite is exposed to the southeast. The rhyolite is so completely silicified and kaolinized that identification is difficult.

Two veins cut the rhyolite. The northernmost, striking N. 55° E. and dipping 30°–40° NW., is 6 to 30 inches in width, and

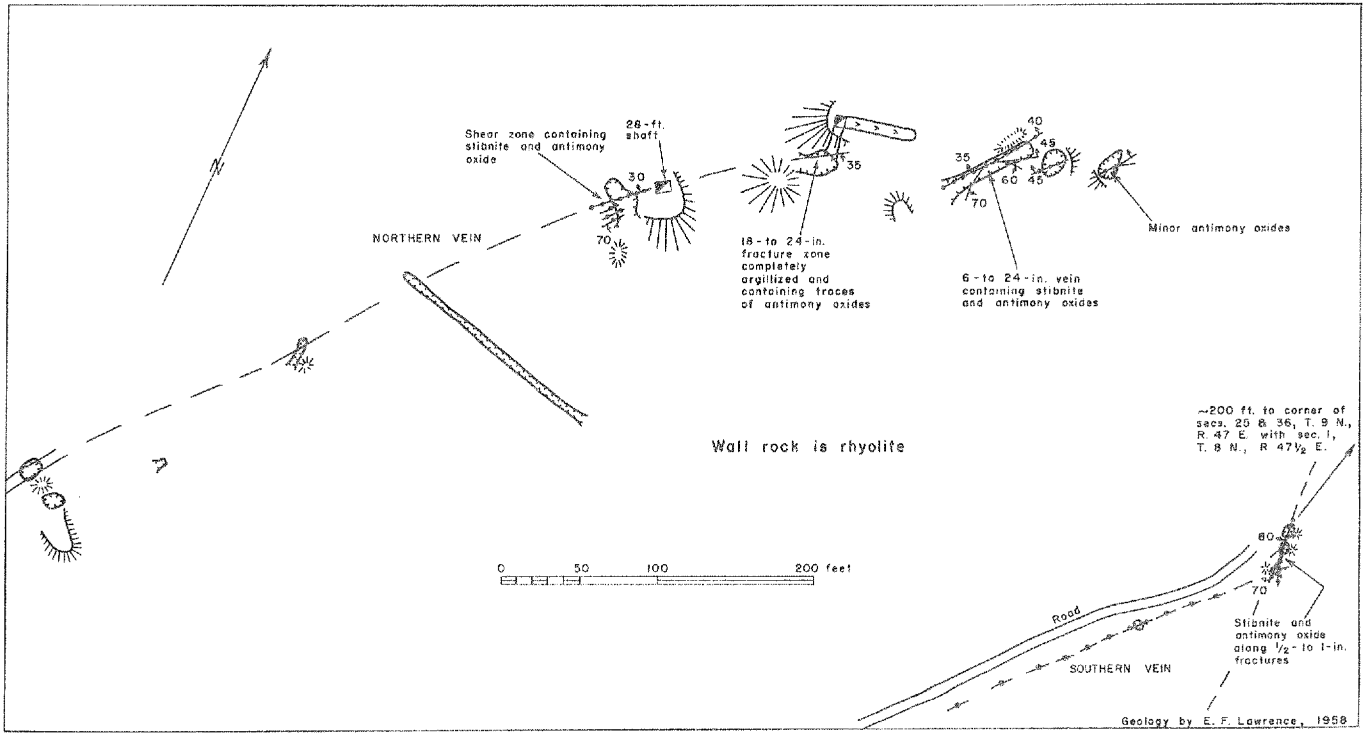

FIGURE 44. Geologic map of the King Solomon mine, Nye County, Nevada.

averages 18 inches. The southern vein which strikes N. 45° E. is approximately 260 feet southeast of the northern vein. A shear zone which strikes N. 5° W. and dips 70° W., cuts off the southern vein. Several small veinlets of quartz and stibnite occur in the shear zone.

The veins contain gouge, some quartz, minor chalcedony, and in the shaft area, barite. Stibnite occurs in stringers, blebs, small pods, radiating clusters, and single crystals lining vugs. It most commonly is bladed, the stubby blades rarely being more than half an inch in length. Some individual crystals and pods are enclosed by white barite that occurs as massive pods and crystals up to 2 inches long in vugs and fractures.

Selenium occurs in the veins. Paul Taylor (private report, 1956) reports assays for selenium of 0.019, 0.112, 0.034, 0.065, 0.047, and 0.18 percent. Of two samples analyzed for selenium, one contained the element, the other did not (see table below).

Stibnite commonly is partially altered to subvitreous, yellow antimony oxide and fibrous, white antimony oxide. The white oxide in some cases is replaced by yellow oxide. There are a few pseudomorphs of yellow and white oxide after tiny clusters of stibnite needles. Antimony and other values found in three samples are shown in the following table:

No.	Description	Sb %	Au oz.	Ag oz.	Se %
195	Grab sample, dump	38.86	0.04	55.16	0.10
196	48-inch shear zone	1.3	None	2.82	None
197	Grab sample, stockpile	12.57	0.04	5.80	....

Milton Canyon mine

Other names .... Humphrey, Kennedy, Mike, Dart.
Location .... Sec. 15, T. 11 N., R. 39 E.
Ownership .... Dart Construction Co.
Antimony production .... 17 tons (metal).
Base map .... USGS Ione 15′ topographic quadrangle.

The Milton Canyon mine workings are along both sides of Milton Canyon on the western flank of the Shoshone Range, 1 mile south of Grantville.

Thirty tons of ore averaging 40 percent antimony were shipped in 1939(?) (White, unpublished data, U. S. Geol. Survey). Mine workings include a 26-foot shaft, 210-foot shaft, a 20-foot shaft, a 34-foot adit, and several shallow pits and short adits (fig. 45).

Gray fossiliferous limestone of the Triassic Luning Formation crops out at the mine (Ferguson and Muller, 1949). In the Milton

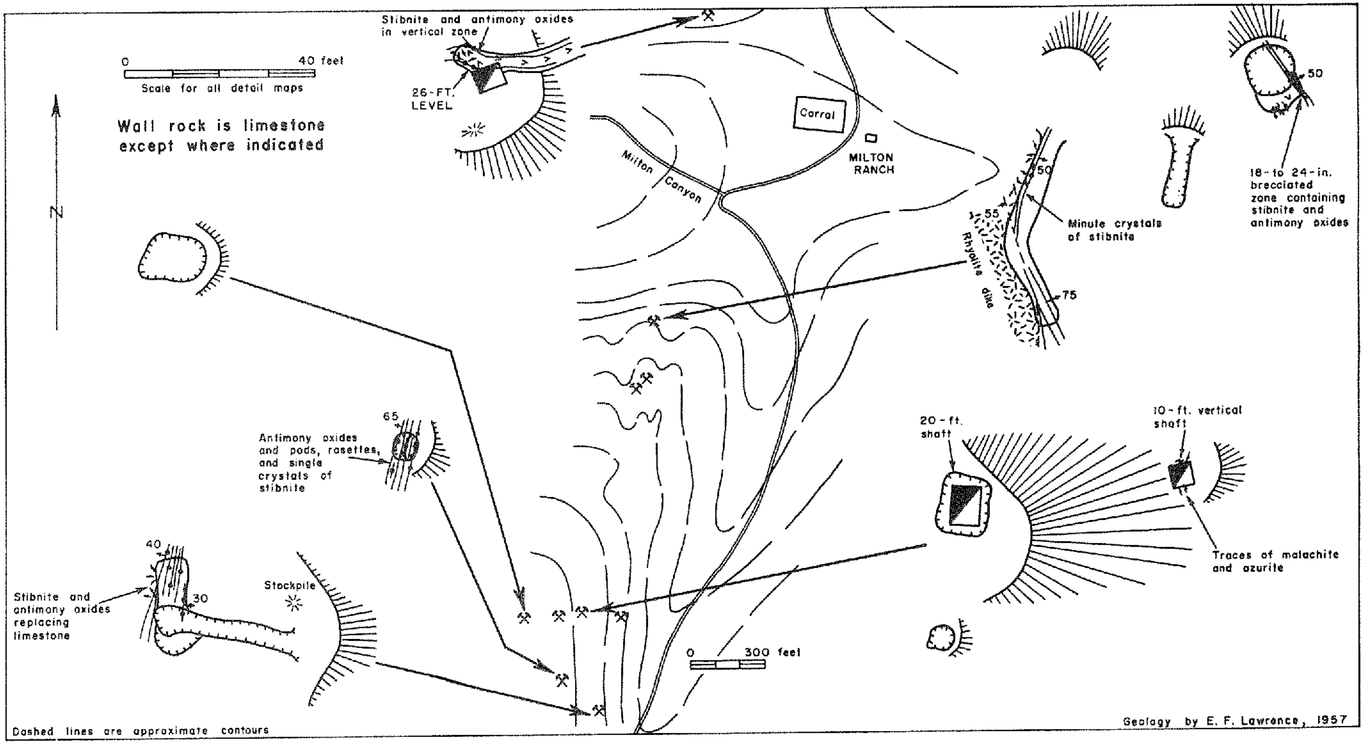

FIGURE 45. Location and geology of the Milton Canyon mine workings, Nye County, Nevada.

Canyon area the limestone is highly contorted. A rhyolite dike, striking N. 15° W. and dipping 55° E., cuts the limestone at the lower adit in Milton Canyon.

Several veins and shear zones cut the limestone. The veins contain silicified fragments of limestone, minor quartz, stibnite, and antimony oxides. Stibnite occurs as blebs, clusters, needles in vugs, small pods, lenses, and single crystals up to 2 inches long. The pods are composed of bladed aggregates. Pyrite occurs with the stibnite in the Milton Canyon adit. Malachite and azurite occur sporadically throughout the area.

The stibnite has been partially altered to white and yellow antimony oxides. Fibrous to vitreous white oxide occurs as pseudomorphs after stibnite. Powdery, earthy, and vitreous yellow oxide occurs as masses, as pseudomorphs after needles of stibnite in vugs, and as coatings on the white oxide. Results of the analyses of two ore samples taken from this mine are given in the following table:

No.	Description	Sb %	Au oz.	Ag oz.	Se %
176	Grab sample, stockpile, Milton Canyon shaft	20.77	None	0.32	Tr.
179	Grab sample, stockpile, southern group	12.57	None	None	None

PERSHING COUNTY

Pershing County contains the State's largest concentration of antimony mines and prospects (see pl. 1). Most known occurrences of antimony within the county, and much of its recorded production, are centered in the mines and mining districts of the Humboldt and West Humboldt Ranges (pl. 10). Within these ranges the mines of the Antelope Springs, Eldorado, Star, and Willard mining districts account for most of the recorded production; additional mines and prospects occur at numerous other locations. Most of the remainder of the County's antimony production has come from the Arabia mining district northwest of Oreana, and from several isolated mines in the east.

At the mines in the northern part of the Humboldt Range and extending as far south as the Bradley and Black Warrior mines (pl. 10), antimony mineralization is spatially associated with the contact between the Weaver Rhyolite of the Koipato Formation and the Star Peak Limestone. The mines and prospects south of this in the Humboldt Range contain antimony deposits associated with Upper Triassic shale, sandstone, limestone, phyllite, and slate, all of which are overlain by basalt flows and intruded by diabase dikes and volcanic plugs. The mines in the West Humboldt Range occur in Jurassic-Triassic sedimentary and volcanic rocks which are overlain by later Tertiary volcanics.

Antelope (Cedar) Mining District

The Antelope district is in the northern part of Pershing County west of Imlay. The Nevada Superior and the Antelope mines have produced copper, lead, silver, and antimony ores. The Majuba mine was operated for copper which occurs in a tourmalinized rhyolite as chalcocite, cuprite, and chrysocolla, associated with arsenopyrite, tourmaline, and fluorite. Cassiterite has also been found in small pods and lenses associated with the copper. Arsenopyrite has been mined half a mile east of the Majuba mine.

Antelope mine

The Antelope mine is approximately 3 miles northwest of Majuba Mountain in sec. 30, T. 33 N., R. 31 E. (see USGS Lovelock 1° topographic quadrangle). It is now owned by Elman and Paul Griffith.

The mine was worked for silver, lead, and antimony. The ore contained less than 1 percent antimony in the form of tetrahedrite.

The mineralized vein which occurs here contains abundant quartz, some galena, tetrahedrite, chalcopyrite, sphalerite, pyrite, and arsenopyrite. Yellow antimony oxides form earthy to powdery coatings on the other minerals. A grab sample of ore on the dump assayed 0.7 percent antimony, 1.1 percent lead, and 9.04 ounces of silver per ton. The wall rock is black Triassic slate.

Bottomley prospects

Other names	Stibnite, Poker Brown.
Location	Sec. 36 (?), T. 31 N., R. 31 E.
Ownership	E. J. Bottomley (1953).
Antimony production	0.5 ton (metal).
Base map	USGS Lovelock 1° topographic quadrangle.

The Bottomley prospects are on the tops of two knolls on the north end of the Trinity Range, 12 miles south of Majuba Mountain.

One shipment of approximately two tons of antimony oxide ore was made after 1950. The mine is developed by several shallow trenches along quartz veins.

Gray to brown shale and interbedded brown, fine-grained sandstone which generally strike N. 40° W. and dip 30° NE., are cut by a series of parallel quartz veins and veinlets, striking N. 70° W. The veins exposed on the southern knoll dip 65°–75° SW.; those on the northern knoll dip 30°–40° NE. They vary from 1 to 12 inches in thickness, and consist of vuggy, milky-white quartz.

Thin needles of stibnite up to 1 inch long are enclosed in euhedral quartz crystals up to 2 inches long. Commonly the stibnite has been oxidized to white or yellow antimony oxides. Stibnite also occurs as blebs, small pods, and single crystals in quartz and in the shale and sandstone. In the northern area pods of stibnite up to 8 inches across occur in quartz veins, and are almost completely altered to fibrous, white and yellow oxides, and less commonly to powdery to earthy white and yellow oxides. Considerable brown iron oxide is associated with the antimony oxides, and pseudomorphs of limonite after cubes of pyrite are common in the veins and adjacent wall rock.

De Soto Antimony mine

Lincoln (1923, p. 201) reported that a shipment of antimony ore was made from Antelope Spring (De Soto) mine in the Antelope (Cedar) mining district in T. 33 N., R. 31 E. The mine is developed by two shallow shafts and a trench. The mineralized vein strikes N. 30° W. and is 6 to 24 inches thick. Antimony occurs in stibnite and minor yellow and white antimony oxides.

Arabia Mining District

The Arabia mining district is in the eastern foothills of the Trinity Range, about 4 miles northwest of Oreana (see USGS Oreana 15′ topographic quadrangle). Although records are incomplete, over 500 tons of antimony metal are known to have been produced from the Arabia district.

Granodiorite containing scattered xenoliths of hornfels is exposed in this district. Locally, Tertiary rhyolite flows overlie the fine-grained granodiorite. The granodiorite is commonly altered to a white granular rock resembling aplite, the feldspar and biotite being sericitized. The hornfels is chiefly metamorphosed Jurassic(?) shale; it is grayish-black and extremely fine-grained, and consists of intergrown quartz and biotite (Knopf, 1918, p. 250).

Numerous veins of quartz and bindheimite cut the granodiorite and hornfels. In the granodiorite the veins have well-defined walls, but are more obscure in the hornfels. Some of the veins can be traced on the surface for over 1,000 feet. The richer ore bodies contain almost solid masses of bindheimite; the leaner ore bodies contain considerable milky quartz with the bindheimite. Minor amounts of fibrous jamesonite occur with the bindheimite. The ore contains up to 80 ounces per ton of silver. The bindheimite most commonly is deep yellowish-brown, amorphous, with a high, brilliant pitchy luster, or is yellow, compact, and earthy.

The following table shows analyses of eight ore samples taken from three mines of this district:

No.	Mine	Description	Sb %	Au oz.	Ag oz.	Se %	Pb %
83	Electric	8-in. vein	1.0	Tr.	7.12	0.010	3.2
84	Electric	15-in. vein	4.16	Tr.	51.50	Tr.	7.4
85	Electric	9-in. vein	5.94	Tr.	13.14	Tr.	7.9
86	Electric	12-in. vein	Tr.	Tr.	2.88	....	....
87	West Group	Grab sample, dump	10.93	None	20.84	....	19.6
88	West Group	12-in. vein	2.52	Tr.	4.24	0.022	3.5
89	Jersey	4-in. vein	2.32	Tr.	34.64	....	1.3
90	Jersey	6-in vein, 40 foot level	1.68	Tr.	58.40	....	....

Electric mine

Location..........Sec. 21, T. 29 N., R. 32 E.
Ownership..........U. S. Smelting and Refining Co.
Base map..........USGS Oreana 15′ topographic quadrangle.

The Electric mine is 1,000 feet north of the Montezuma mine, and several hundred feet west of the Jersey mine. In 1929 and 1930, 834 tons of ore averaging approximately 17 percent antimony, 25 percent lead, and 0.1 ounce of gold per ton were shipped. Shipments also were made in 1944. The mine is developed by numerous shafts, adits, trenches, and open pits. Considerable stoping has been done.

Numerous veins are seen at the Electric mine (pl. 11); all trend north and dip 35°–70° E. They are slightly arcuate, and are offset a few feet in several places by cross faults. They vary in thickness from less than an inch to over 6 feet, averaging 8 to 12 inches, and are composed principally of quartz and gouge, with minor calcite. Plumbojarosite, bindheimite, and other antimony oxides are locally abundant. Unoxidized jamesonite occurs only rarely, but a few remnants are found on the lower levels, commonly surrounded by "woody splinters" of bindheimite and powdery antimony oxides.

Jaxrace Jewel prospect

Location	Sec. 21, T. 29 N., R. 32 E.
Ownership	Harry and J. H. Green, of Lovelock.
Production	None.
Base map	USGS Oreana 15′ topographic quadrangle.

The Jaxrace Jewel claims are in the wash less than a quarter of a mile west of the Jersey mine. The claims have been developed by a 25-foot shaft and several trenches. A vein 2 to 8 inches in width, striking N. 20° W. and dipping 45° E., is exposed. It is composed of brecciated quartz and oxides, estimated to contain 5 percent antimony.

Jersey mine

Location	Sec. 21, T. 29 N., R. 32 E.
Ownership	U. S. Smelting and Refining Co.
Base map	USGS Oreana 15′ topographic quadrangle.

The Jersey mine is on a single narrow claim 1,000 feet north of the Montezuma mine, and several hundred feet east of the Electric mine. It is developed by several inclined shafts, trenches, pits, an adit, and short drifts (pl. 12).

The vein, striking N. 25°–40° E. and dipping 35°–60° E., is 6 to 24 inches wide, and consists of quartz, pitchy bindheimite, and other antimony oxides. It is similar to the veins at the Electric mine. Knopf (1918, p. 254) mentioned that a post-mineral fault offsets the vein a few feet.

Montezuma mine

Location	Sec. 21, T. 29 N., R. 32 E.
Ownership	U. S. Smelting and Refining Co.
Base map	USGS Oreana 15′ topographic quadrangle.

The Montezuma mine is 4½ miles northwest of Oreana. It has been the chief producer in the Arabia district.

In 1865, a smelter, the first operated in Nevada, was built at Oreana to treat the ore from the mine; earlier attempts to reduce it in a stamp mill had been unsuccessful. At first only silver was recovered but when completion of the Central Pacific Railway lowered transportation costs, antimony and lead also were recovered and marketed profitably. An alloy of lead and antimony was recovered from the shaft furnace, and sold without further treatment to Selby and Co. of San Francisco. Hague (1870, p. 308) described the old smelter and smelting methods in detail. The ore from the mine contained 40 to 50 percent lead and antimony, and 60 to 80 ounces of silver per ton. In 1917, the smelter slags, which averaged 7 percent lead, 5 percent antimony, and 2 ounces of silver per ton, were shipped to the smelter at Midvale, Utah. At the same time that the slag was being shipped, tailings from the old stamp mill were uncovered; according to Knopf (1918, p. 253) they averaged 18 percent antimony, 24.7 percent lead, and 17 ounces of silver per ton.

The main vein trends east-west and dips 45°–55° N. (pl. 12). It averages 6 feet in width at the surface but narrows downward to 1 to 2 feet. Hornfels is exposed on the 176-foot level; the other workings are in granodiorite. The main ore shoot appears to have been 90 feet long and up to 20 feet wide in the pit, but pinches out a short distance below the surface. Both to the east and west, the vein apparently ends against northeast-trending, steeply southeast-dipping faults (pl. 12).

The vein consists mainly of quartz and gouge, minor calcite, and locally abundant jamesonite and antimony oxides. Only a few small pods and blebs of the jamesonite remain, most of it having been oxidized. The antimony oxide, bindheimite, occurs as earthy to pitchy pods filling the entire vein. Other antimony oxides also occur as pods and powdery masses in the vein and adjacent wall rock. Arsenopyrite is relatively common, and in places has been oxidized to scorodite. Cerussite and gypsum are fairly common.

West Group

Location .... Sec. 20, T. 29 N., R. 32 E.
Base map .... USGS Oreana 15′ topographic quadrangle.

The West Group of prospects is about half a mile northwest of the Electric mine. Six major veins exposed in this area have been developed by numerous adits, shafts, open cuts, and considerable stoping (pl. 13).

The wall rock usually is sericitized granodiorite, but in places it is hard, dense, brown to gray hornfels. The veins generally strike N. 15° E. to N. 15° W. and dip 45°–60° E. Several cross faults slightly offset the veins. The veins are 1 to 24 inches thick and consist principally of brecciated wall rock and varying amounts of quartz. Some of the quartz has been brecciated and recemented by later quartz. Jamesonite occurs as blebs and small pods, except in the deeper workings, where it has been converted to bindheimite and other antimony oxides. Some of the bindheimite is resinous and hard, and some is powdery with a woodlike structure. Arsenopyrite, yellow iron oxides, and jarosite are commonly associated with the ore. These veins are similar to the other veins of the Arabia district, but show less mineralization.

Several shallow shafts, prospect pits, trenches, and adits along the ridge a thousand feet to the east explore veins trending north and dipping steeply eastward. These are similar to the other veins of the district, but are only very weakly mineralized. The wall rock is sericitized granodiorite.

Other occurrences

In 1917, T. E. Ludwick is reported to have mined some ore assaying 22 percent antimony, 27 percent lead, and 10 ounces of silver per ton; this was sold to P. W. Shelby of Chapman Smelting Co. In 1936, John Flynn and Al St. Clair mined 38 tons of ore averaging 15 percent antimony. In 1939, R. B. Whitman and S. E. Kimber produced five tons of ore containing 14 percent antimony. Also in 1939, Kenneth Dale and Richard Collins produced 14 tons of ore assaying 16 percent antimony. All of this production apparently was from the Arabia mining district. Whether it represents ore from mines described in the preceding section, or is from undescribed occurrences, is not known.

Antelope Springs Mining District

Stibnite, bindheimite, and other antimony oxides occur in several of the mercury mines of the Antelope Springs mining district in T. 26 N., R. 34 E. (see USGS Buffalo Mountain 15′ topographic quadrangle). Upper Triassic shale, siltstone, sandstone, limestone, phyllite, and slate are overlain by basalt flows and intruded by diabase dikes and volcanic plugs. The geology has been described in some detail by Wallace and others (1959), and the mines have been described by Bailey and Phoenix (1944, p. 159).

Antimony Star mine

Other names	Eagle claim.
Location	Secs. 4 and 5, T. 26 N., R. 34 E.
Ownership	George H. Johnson, Lovelock (1957).
Production	None.
Base map	USGS Buffalo Mountain 15′ topographic quadrangle.

The Antimony Star mine is one-fourth of a mile northeast of the Cervantite mine, in the southern part of the Humboldt Range, known locally as the Buffalo Mountains.

The deposit is developed by two short connected adits, totaling 35 feet (fig. 46).

The antimony mineralization occurs as an extention of the same northwest-trending structure found in the Cervantite mine. The mine is in a series of shales, sandstones, and quartzites of Jurassic Age (Wallace and others, 1959), similar to the rocks at the Cervantite mine.

The main workings explore a contact, striking N. 40° W. and dipping 30° E., between brown to reddish-brown sandstone and

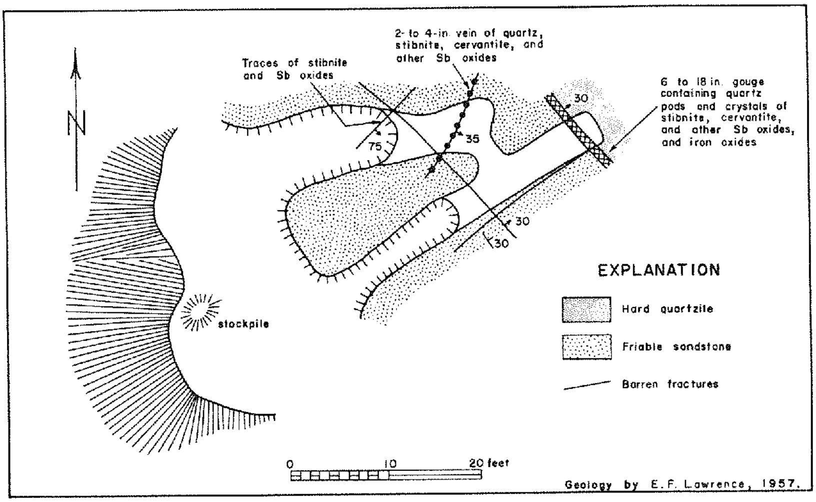

FIGURE 46. Geologic map of the Antimony Star mine, Pershing County, Nevada.

gray to brown quartzite. Yellow to gray shale crops out along the hillside below the mine. Fractures and faults occur in the sandstone along the footwall of the sandstone-quartzite contact; individual structures follow and parallel the contact and bedding, or crosscut the bedding at large angles.

Veins of quartz and stibnite are found in many of the fractures and faults. Stibnite is present as pods, stringers, and individual crystals in the veins, and also as disseminations in the sandstone. Much of the stibnite has been oxidized to yellow and white antimony oxides. Analyses of two samples taken from this mine are shown in the accompanying table. The sandstone has been argillized for several feet outward from the veins and locally is bleached, flooded with carbonates, and/or stained by brown iron oxides.

No.	Location	Description	Sb %	Au oz.	Ag oz.
26	Dump	Grab sample	2.48	None	0.62
27	Adit, at face	18-inch gouge zone containing quartz, stibnite, and Sb oxides	1.18	None	0.62

The fractures probably resulted from differential movement along the contact, the softer sandstone being broken, while the hard quartzite remained relatively unaffected. The hard quartzite apparently was a barrier to upward movement of the mineralizing solutions, and the antimony minerals were deposited in the fractures in the sandstone below.

Cervantite mine

Other names..........Kafader, Dakin.
Location..........Sec. 4, T. 26 N., R. 34 E.
Ownership..........Fred Dakin (1960).
Production..........2 tons antimony (metal).
Base map..........USGS Buffalo Mountain 15′ topographic quadrangle.

The Cervantite mine lies half a mile north of the Montgomery quicksilver mine, and a quarter of a mile southeast of the Antimony Star mine. The Cervantite mine and the Antimony Star mine both lie along the same mineralized structure.

Two carloads of antimony ore reportedly were produced during World War I. Approximately five tons of ore averaging 56 percent antimony were shipped from 1941 to 1951. The mine is developed by a 19-foot shaft (fig. 47) with a short crosscut and stope along the vein, a 35-foot adit along the vein just west of the shaft, several small cuts, and a considerable amount of bulldozing. All workings are accessible.

The openings are in a reddish-brown to brown, fine-grained sandstone that strikes N. 45° W. and dips 70° NE. This sandstone is overlain by dense gray to brown quartzite, and underlain by green, brown, and pale-yellow, highly fissile shale, all of probable Jurassic Age (Wallace and others, 1959). Intense fracturing and faulting have taken place both along the sandstone-quartzite contact and in the sandstone oblique to the contact.

Stibnite occurs as small pods and stringers in quartz along the crosscutting structures (fig. 47). Much of it has been oxidized to white and yellow antimony oxides. Commonly, a small center of white antimony oxide up to half an inch across is surrounded by a concentric ring up to three-fourths of an inch wide of stibnite, which is in turn enclosed by a halo of white and yellow antimony oxides. Wall rock alteration is weak; only a small amount of clay and sericite is present.

The fractures and faults in the sandstone apparently are the result of differential movement which did not break the hard quartzite and could not produce open fractures in the soft shale. These openings in the sandstone later provided channels for the upward movement of the ore solutions, and also provided the open space in which stibnite was deposited.

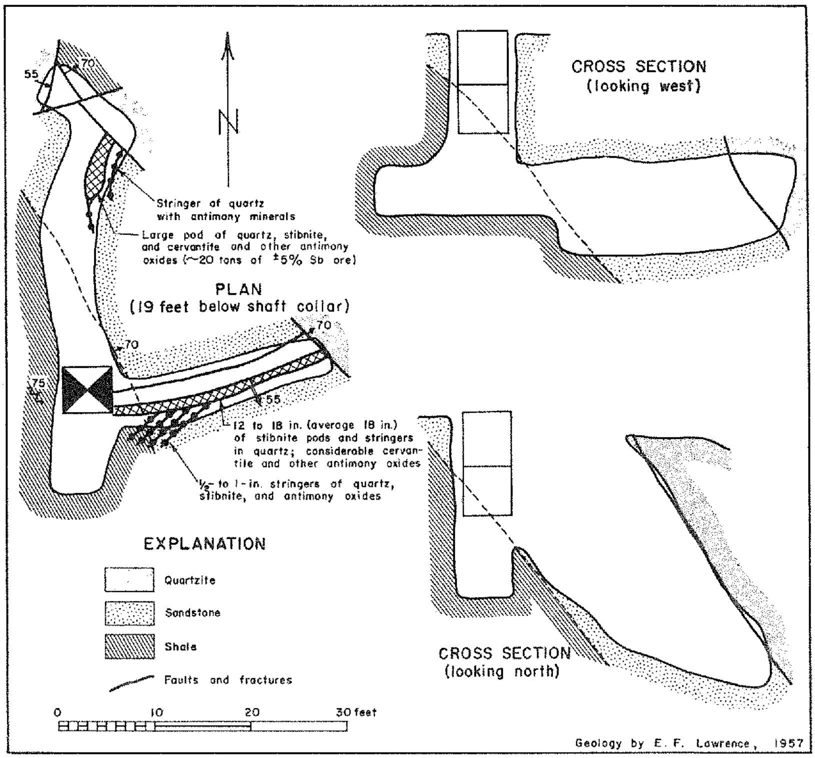

FIGURE 47. Geologic plan and sections of the Cervantite mine, Pershing County, Nevada.

Empire claims

Other names..........Three I's, Brammier-Fields, Red Top.
Location..........Sec. 5, T. 26 N., R. 34 E.
Ownership..........Ed Bottomley and Bob Storms (1957).
Production..........Small.
Base map..........USGS Buffalo Mountain 15′ topographic quadrangle.

The Empire claims are located 1 mile northwest of the Pershing Quicksilver mine in the Antelope Springs mining district.

John A. Brammier and J. R. Fields produced one ton of ore assaying 56 percent antimony (White, unpublished data, U. S. Geol. Survey). The mine is developed by a 20-foot shaft and two open cuts.

A vein 1 to 3 inches in width, striking N. 20° W. and dipping 55°–85° W., is exposed in the shaft 400 feet north of the road. The hanging wall is a limestone breccia recemented by dolomite; the footwall is yellow to brown shale striking N. 20° W. and dipping steeply westward. Stibnite occurs as small pods, blebs, and veinlets in quartz and calcite associated with cinnabar. The stibnite has been partially altered to yellow and white antimony oxides. The Pershing Quicksilver mine and the Montgomery mines are on the strike of this vein.

The open pit 1,000 feet north of the shaft contains stibnite and cinnabar in gouge. These minerals also occur between the shaft and open cut as replacements along fractures in a breccia of limestone fragments recemented by dolomite.

Friendship mine

The Friendship mine (Huntley prospect) is in sec. 12, T. 26 N., R. 34 E., 1 mile southeast of the Hollywood mine (see USGS Buffalo Mountain 15′ topographic quadrangle). In 1948 considerable bulldozing and trenching were done in an unsuccessful attempt to uncover antimony ore bodies (John Heizer, oral communication, 1960). The prospect is on a fracture in limestone breccia, near a contact with shales and siltstone of Upper Triassic Age (Wallace and others, 1959). Antimony is present in various oxides and also as stibnite associated with cinnabar.

Hollywood mine

Other names	Lakeview, Antelope Springs, Lee.
Location	Sec. 2, T. 26 N., R. 34 E.
Ownership	Alma D. Priester, of Hollywood, California (1960).
Production	512 tons antimony (metal).
Base map	USGS Buffalo Mountain 15′ topographic quadrangle.

The Hollywood mine is located in the Antelope Springs mining district on the south flank of the Humboldt Range.

The mine was discovered by George Senn in 1864. Twenty-five hundred tons of antimony ore were mined during World War I (Hess, unpublished data, U. S. Geol. Survey), and a small amount of ore was produced in 1939. In 1940, five tons of ore containing 56 percent antimony were produced. In 1941 the mine was optioned to Antimony Producers Co. and two small ore shipments were made the same year. Ore is developed by three adits and numerous small pits and trenches as shown in plate 14.

Yellow, gray, and brown, calcareous shales and interbedded limestone and siltstone of the Upper Triassic Grass Valley Formation crop out at the mine (Wallace and others, 1959). The shales generally strike northwest to west and are highly contorted. Bedding plane faults are locally abundant. Just east and north of the mine these beds have been intruded by a number of diabase dikes. Numerous masses of white quartz are exposed on the hills above and north of the mine.

Antimony ore has been extracted from two areas. The first mining was done on an ore shoot in the lower adit near the portal, where the vein strikes N. 35°–60° W. and dips 60°–65° NE. The northwest segment of this vein is offset to the southwest by a fault striking N. 60° E. A number of other faults parallel the vein or have other orientations. The vein is 12 to 36 inches wide and has been stoped to the surface.

A second ore shoot in the lower adit, some 250 feet southwest of the portal, also is exposed in the upper adit. This shoot occurs at the intersection of a vein striking N. 45° W. and dipping 45° SW. with one that strikes north and dips 30° W. The ore shoot has been stoped above the lower adit and from the upper adit to surface. More recent exploration below the lower adit by winzing along the rake of the vein intersection proves that the ore shoot pinches out downward.

The veins are irregular, both in width and dip. Numerous splits and cross faults complicate them. They most commonly consist of clear to milky quartz, commonly granulated and recemented by quartz. A small amount of calcite also is present. Pods up to 30 inches across, disseminated grains, and individual crystals of stibnite are scattered through the veins. The stibnite commonly is equigranular and bladed. Pyrite is associated.

Yellow and white antimony oxides occur throughout the mine. The white oxide is more common near the surface. The powdery, resinous, yellow oxide occurs as films along cleavage planes and fractures in the stibnite, as coatings along bedding planes and fractures in the shaly wall rock, and as halos around kernels of stibnite. A red oxysulfide (kermesite?) also is found along cleavage planes in stibnite, but is somewhat less abundant than the yellow oxide. Limonite pseudomorphs occur after pyrite.

The wall rock is partially argillized and silicified. Antimony, silver, and gold values found in seven ore samples from this mine are given below:

No.	Location	Description	Sb %	Au oz.	Ag oz.
57	Lower adit, end of northwest drift	6-inch vein	5.83	Tr.	0.62
58	Lower adit, end of northwest drift	12-inch vein	3.98	Tr.	0.46
59	Lower adit, end of northwest drift	18-inch vein	10.0	None	0.60
60	Lower adit, 150 feet from portal	18-inch vein	29.42	Tr.	0.04
61	Lower adit, 90 feet from portal	30-inch vein	7.81	None	0.00
62	Lower adit, main vein	24-inch vein	5.20	Tr.	0.68
63	Upper adit, 55 feet from portal	60-inch vein	1.91	Tr.	0.40

Other occurrences

Juniper mine. The Juniper mine is in sec. 32, T. 27 N., R. 34 E., 2 miles north of the Pershing mine. Bailey and Phoenix (1944, p. 163) reported that:

"Some of the ore from the upper parts of the mine contained considerable stibnite, and in the lower levels scattered pods of ore are reported to have contained an even higher percentage of stibnite."

An examination of the accessible workings failed to reveal more than a few small pods and blebs of stibnite and small patches of yellow antimony oxides.

Montgomery mine. The Montgomery mine is located in secs. 15 and 16, T. 26 N., R. 34 E., southeast of the Pershing mine. The mine is owned by Sanford Bunce and Roy Hawkins of Lovelock, and in 1960 was being drilled by Utex Exploration Co. A vein 10 to 14 inches wide, striking N. 40° W. and dipping 30° SW., contains cinnabar, stibnite, and brecciated fragments of limestone. The vein is continuous for 40 feet, but does not appear in a crosscut 50 feet up the winze. Stibnite occurs as blebs and single crystals, and as small pods up to 1 inch across. Minor antimony oxides are also present. Cinnabar and stibnite are so closely associated as to suggest simultaneous deposition.

Pershing mine. The Pershing mine is in secs. 8, 9, 10, and 16, T. 26 N., R. 34 E., on the same ridge as the Montgomery mine. Minor stibnite, antimony oxides, pyrite, galena, and sphalerite are associated with cinnabar.

Red Bird mine. The Red Bird mine is in secs. 28 and 33, T. 27 N., R. 34 E., approximately 2 miles northeast of the Pershing mine. Powdery to earthy bindheimite and other antimony oxides are closely associated with cinnabar. Pyrite and sphalerite also are common.

Eldorado Mining District

Motor prospect

Location .... Sec. 23, T. 31 N., R. 33 E.
Ownership .... Mrs. Robert R. Gamble, of Monterey, Calif. (1957).
Production .... None.
Base map .... USGS Imlay 15′ topographic quadrangle.

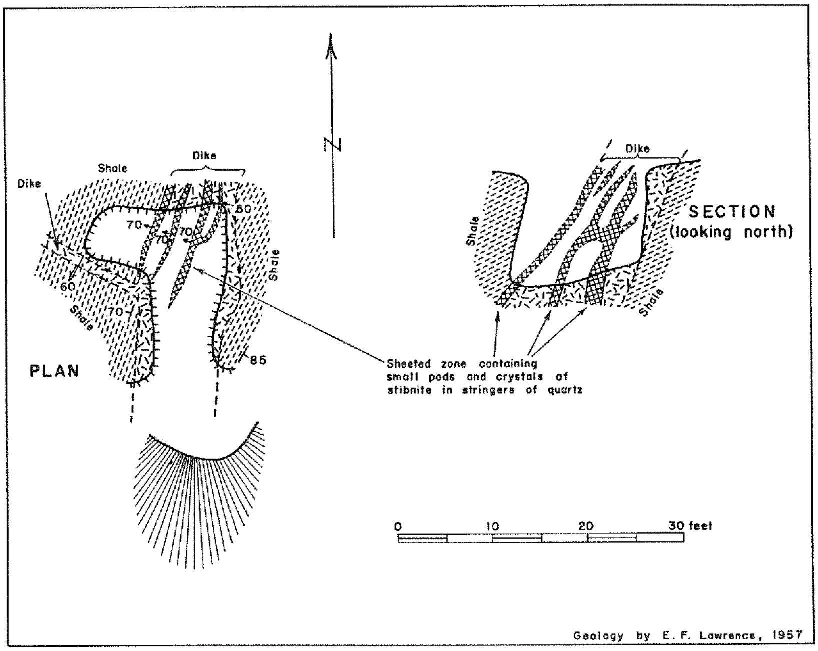

FIGURE 48. Plan and section of the Motor prospect, Pershing County, Nevada.

The Motor prospect is in the El Dorado mining district on the north side of Antelope Canyon on the west slope of the Humboldt Range.

The prospect consists of one small open cut (fig. 48) in brown, black, and gray shale. These beds have a general N. 30° E. strike and 70° W. dip and rest unconformably on gray, finely crystalline limestone that strikes N. 20° W. to N. 10° E. and dips 20°–60° W. The sediments are intruded by a diabase dike that strikes N.

20° W. to N. 10° E., and dips 70° W. In the cut the dike is almost completely altered but retains a relict diabasic texture. In the creek bed below, the dike has been sericitized and slightly silicified in spots.

Several quartz veins 2 to 12 inches in width occur in the dike at the open cut and probably extend for 100 feet south where ore becomes 12 to 24 inches wide. In the cut antimony occurs as small pods and single crystals of stibnite and as antimony oxides. No antimony minerals were noted in the vein south of the open cut. The table shows analyses of antimony, gold, and silver values in two ore samples taken from the Motor prospect.

No.	Location	Description	Sb %	Au oz.	Ag oz.
77	Open cut	4-inch quartz vein with stibnite	5.23	None	0.48
78	Open cut	3-inch quartz vein with stibnite	27.96	Tr.	0.48

Star mine

Other names..........Griff.
Location..........Sec. 26, T. 31 N., R. 33 E.
Ownership..........Winnemucca Mountain Mines Co. (1957).
Production..........None.
Base map..........USGS Imlay 15′ topographic quadrangle.

The Star mine is located in the El Dorado district on the north side of Eldorado Canyon in the west flank of the Humboldt Range.

In recent years, the mine was worked for tungsten (scheelite). Workings include a number of adits and shafts, of which only several expose antimony mineralization (fig. 49).

Gray, massive, locally highly contorted limestone, with a general strike of N. 50° E. and dip of 65°–80° N., crops out at the mine. It is Middle Triassic in age. Several diabase(?) dikes, having quite irregular strikes and dips, have intruded the limestone. Antimony occurs in stibnite and antimony oxides in pods, streaks and individual grains, commonly in quartz veins and masses, in or close to the dikes. Small amounts of tetrahedrite, partially oxidized to malachite and azurite, are associated with the stibnite. Pyrite is also quite common in the unoxidized zone. The occurrence of antimony here is similar to that in the Bradley, Motor, and Panther Canyon mines.

Scheelite occurs in mineable quantities in the lower adits, but no antimony minerals were noted there. Scheelite is rare in the upper adit where the antimony and copper mineralization occurs.

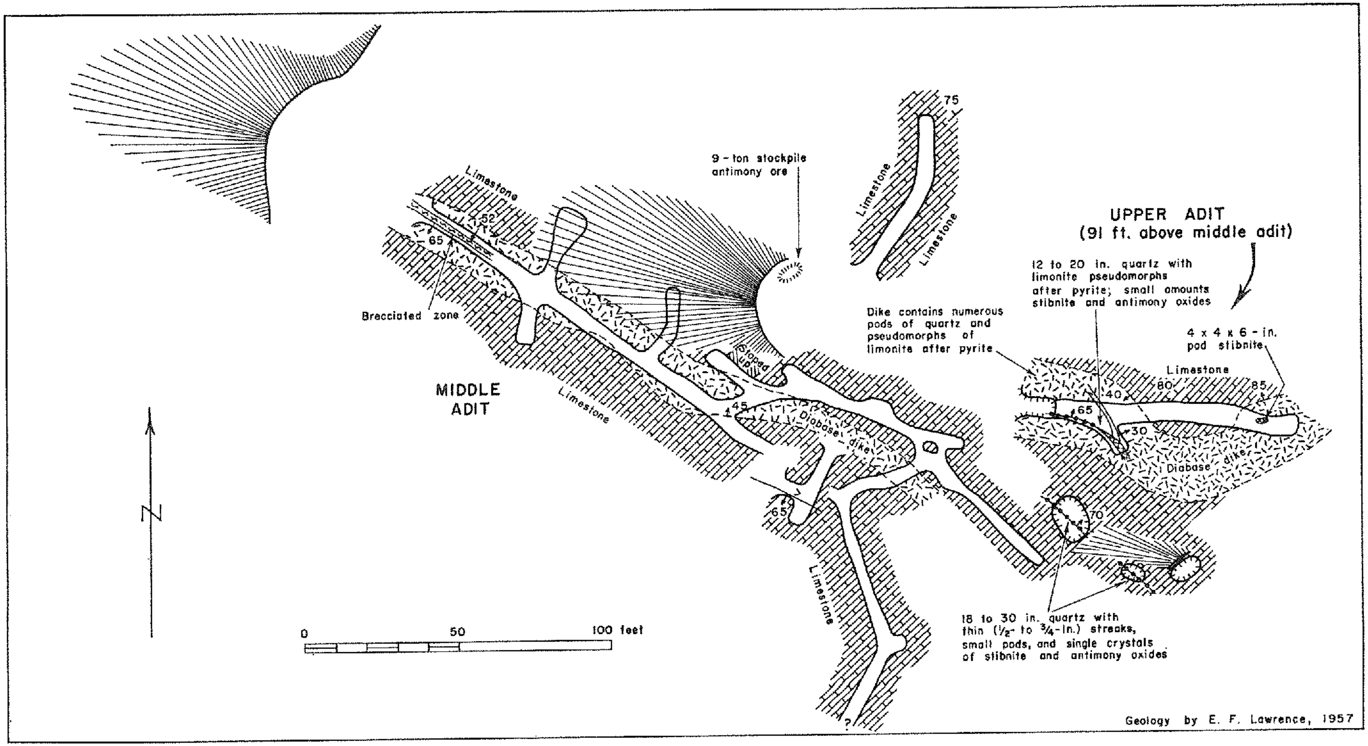

FIGURE 49. Geologic map of the Star mine, Pershing County, Nevada.

The diabase dike has been almost completely altered to carbonates, chlorite, and clays, and contains numerous pseudomorphs as limonite after pyrite. In some areas the dike has been almost completely silicified with only a few plagioclase grains remaining unaffected. In thin section, the silicified rock commonly shows a relict diabasic texture. The limestone has been recrystallized in places along the dike. Antimony, gold, and silver values found in four ore samples collected at this mine are shown in the following table:

No.	Location	Description	Sb %	Au oz.	Ag oz.
73	Upper prospect pit	Quartz-stibnite-antimony oxide stringer	12.83	None	1.12
74	Upper adit	12-inch vein	40.27	Tr.	0.94
75	Stockpile	Vein material	21.03	Tr.	10.62
76	Upper adit	Large quartz-stibnite pod	11.04	Tr.	13.98

Star Mining District

Bloody Canyon mine

Other names........Red Star, Hutton.
Location........Sec. 35, T. 31 N., R. 34 E.
Ownership........Hybert L. Neal, of Winnemucca (1960).
Production........1,218 tons antimony (metal).
Base Map........USGS Imlay 15′ topographic quadrangle.

The Bloody Canyon mine is located on the west side of the south branch of Bloody Canyon in the Star mining district on the east slope of the Humboldt Range. This mine has been the largest producer of antimony ore in Nevada and probably in the United States. It may have been worked for silver in the 1860's. The first antimony was produced in 1907 when 352 tons of ore valued at $52,500 were shipped. The National Antimony Co. acquired the mine from the First National Bank of Winnemucca in 1917, and 1,625 tons of antimony ore were produced before the company was dissolved in 1921. This company also tried to make antimony oxide in a muffle furnace, but was unsuccessful. In 1937, the Nevada Antimony Mines, Inc. operated the mine and produced some ore, however it soon reverted to the then owner, William A. Hutton, who built a 25-ton mill. In 1941, J. F. McCarthy, of Antimony Ltd., built a 10-ton Steele furnace to produce antimony oxide.

The following table indicates the production of the Bloody Canyon mine:

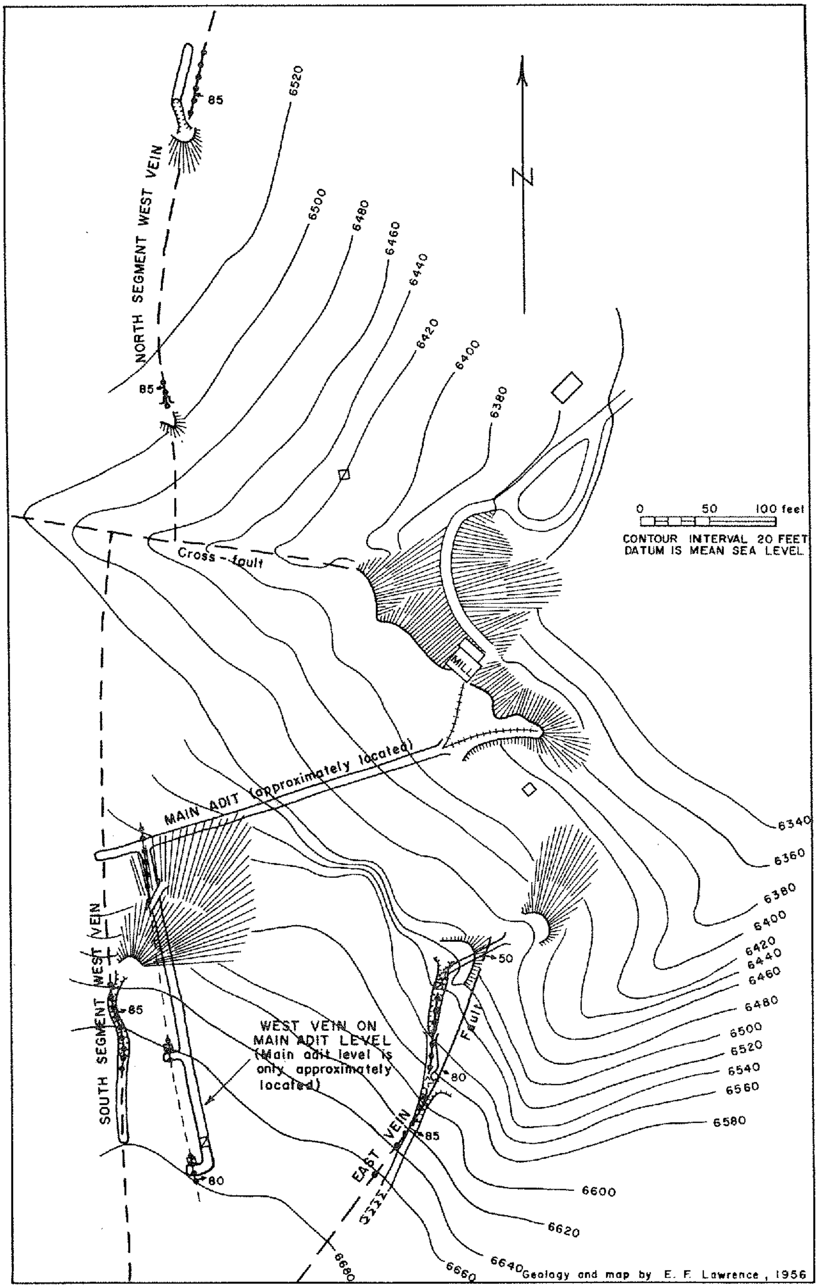

FIGURE 50. Map of the Bloody Canyon mine, Pershing County, Nevada.

Year	Tons of ore	Grade (percent Sb)
1907	352	60
1912	10	60
1917–21	1,625	60
1938	10	60
1940	30	13
1942	3	55
Total	2,030	

The property consists of four claims and a mill site. The Red Star No. 1 claim is patented. The mine is extensively developed (fig. 50).

The main adit cuts the west vein approximately 200 feet below the surface, and stopes extend above this level (fig. 51). Several short adits and trenches explore the surface exposures of this vein. Short adits and trenches also follow the east vein (fig. 52), and some stoping has been done from these workings. All workings except parts of the stoped area above the main adit are accessible.

The two veins are in the uppermost rhyolite flow of the Koipato Formation that generally strikes N. 15° W. and dips 45° W. The rhyolite is flow-banded, but locally it contains numerous fragments and has the appearance of a volcanic breccia. In the mine area, the rock is almost completely silicified, but near the veins a few completely sericitized relicts of lath-shaped feldspar(?) remain. The groundmass has been replaced by cryptocrystalline chalcedony and cut by veinlets of quartz; some small feldspar laths are replaced by quartz.

Gray crystalline limestone and interbedded tuffaceous sandstones and silt-stones of the Star Peak Formation overlie the rhyolite, and crop out a short distance west of the workings. A conglomerate, containing fragments of volcanic rocks, occurs the near the base of this formation.

The north-trending west vein is offset by an east-west fault (fig. 50). The northern vein segment strikes N. 10° E. and dips 85° W., and is relatively barren. The southern segment (fig. 53) strikes N. 10° W., dips 80°–85° E., and contains abundant stibnite over several feet in width.

The east vein strikes N. 10°–25° E. and dips 80°–85° E. A barren fault striking N. 25° E. and dipping east intersects the vein (fig. 52). The east vein varies both in thickness (from less than a foot to twelve feet), and in content of stibnite.

Quartz is common in both veins. Stibnite occurs as pods, streaks, and single crystals in the quartz, and in gouge. Pyrite is fairly common, both in the veins and disseminated through

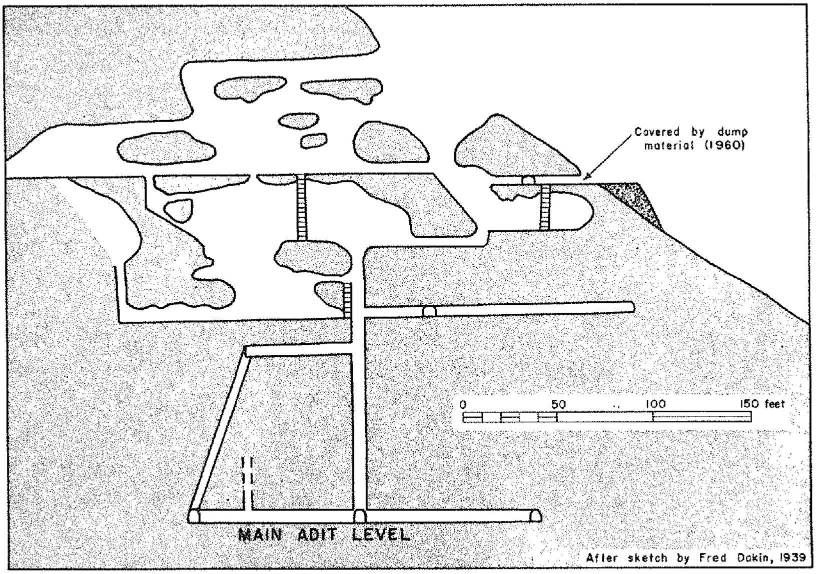

FIGURE 51. Section along south segment of the west vein, Bloody Canyon mine (looking west), Pershing County, Nevada.

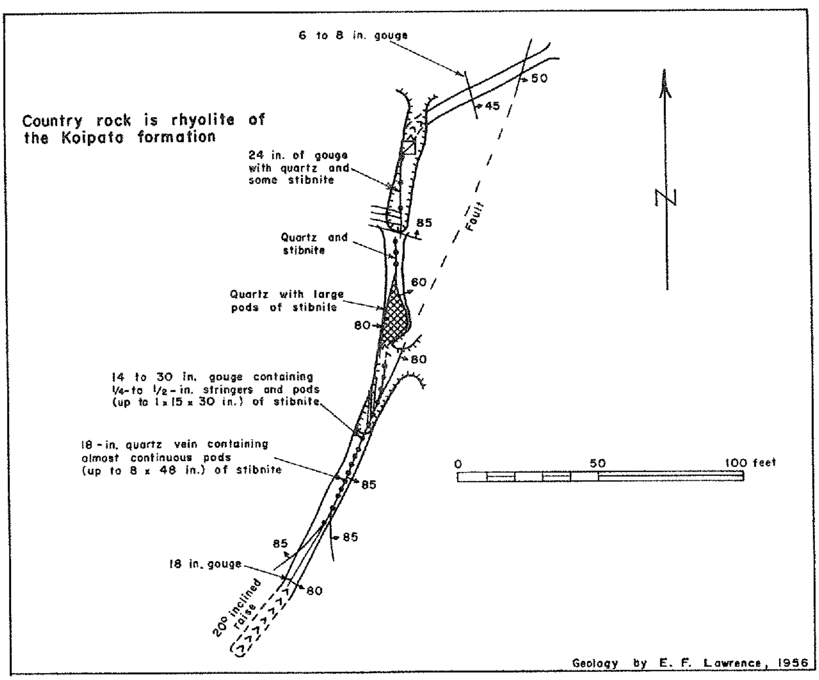

FIGURE 52. Geologic map of workings along the east vein, Bloody Canyon mine, Pershing County, Nevada.

the wall rock. Rarer chalcopyrite occurs sporadically throughout the stibnite-bearing parts of the veins. Stibnite has been oxidized and leached. Residual yellow antimony oxides occur with it; white and yellow transported antimony oxides also are present but appear to have migrated only short distances. Pyrite also has been oxidized and leached, with halos of reddish-brown limonite commonly surrounding the sulfide grains. The table below shows antimony and other values found in two samples of ore taken from this mine.

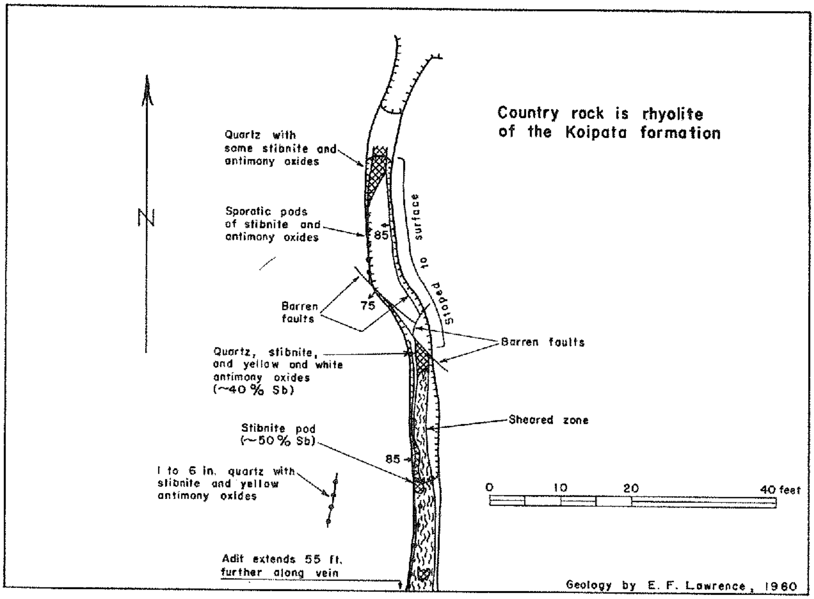

FIGURE 53. Geologic map of workings along south segment of the west vein, Bloody Canyon mine, Pershing County, Nevada.

No.	Location	Description	Sb %	As %	Se %	Au oz.	Ag oz.
99	Dump, lower adit, east vein	Vein material	65.55	None	None	None	None
100	Upper (southern) adit, east vein	30-inch vein	34.58	Tr.	None	None	0.44

Pflum mine

Other names .... Last Chance, Star Canyon, Pacific, Honeybunny, Prospector, Midnight, Picnic.

Location .... Sec. 22, T. 31 N., R. 34 E.

Base map .... USGS Imlay 15′ topographic quadrangle.

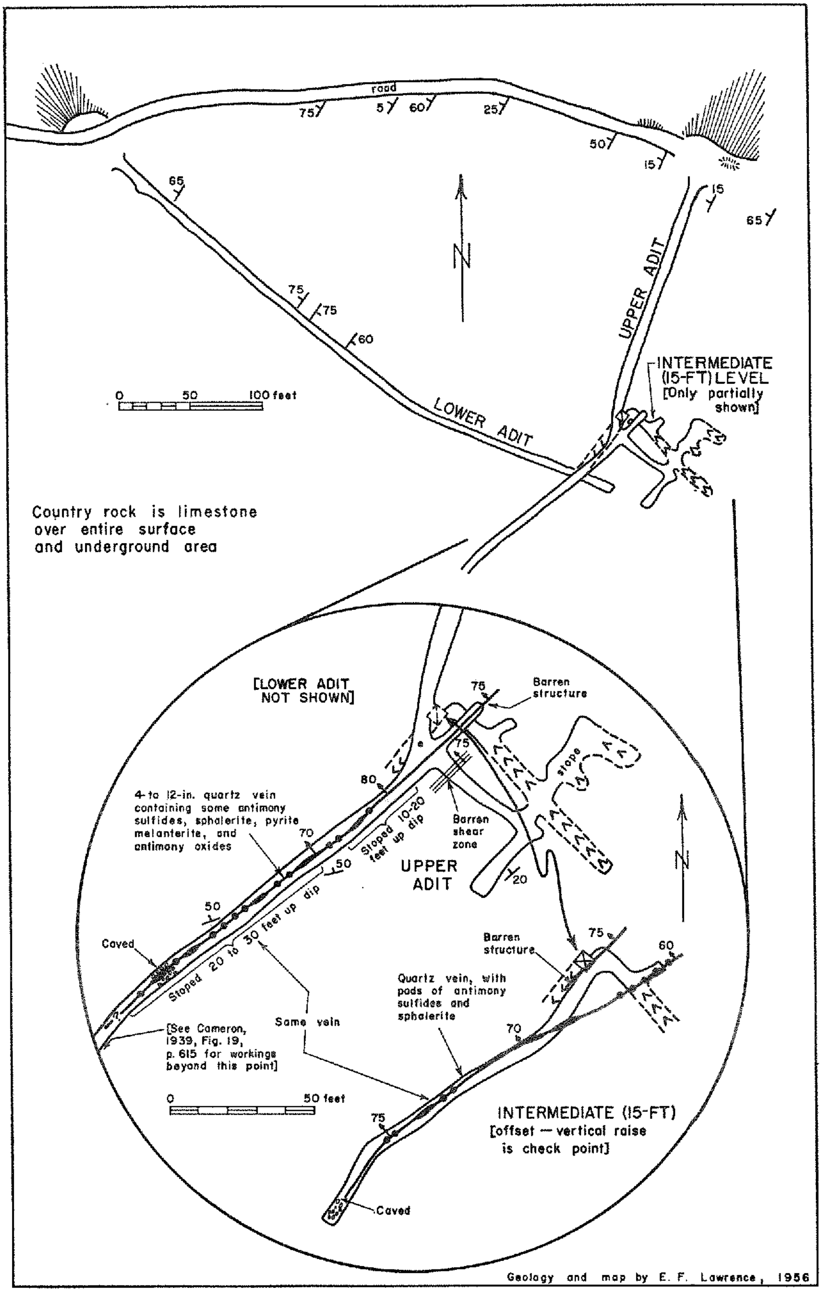

FIGURE 54. Geologic map of the Pflum mine, Pershing County, Nevada.

The Pflum mine is on the south side of Star Canyon one mile below the Sheba and Desoto mines, in the Star mining district on the east flank of the Humboldt Range.

The mine is developed by more than a thousand feet of workings, including two adits, an intermediate (15-foot) level, raises connecting the three levels, and some stoping (fig. 54). Some of the workings along the vein are inaccessible.

The country rock at the Pflum mine is silty, thin-bedded to shaly, black to gray limestone of the Triassic Star Peak Formation. The limestone is folded into numerous small anticlines and synclines but has a general N. 30° E. strike. It contains up to 35 percent quartz as silt-size grains, considerable carbonaceous material, and some white mica.

A quartz-antimony vein 4 to 12 inches in width, striking N. 50° E. and dipping 70°–80° NW., cuts the limestone. Several barren faults closely parallel the vein. The vein apparently is offset by a subhorizontal bedding-plane fault, giving the appearance of two veins, but no evidence was found that either vein segment extends beyond the plane of the fault.

Stibnite is not abundant. It occurs as small pods and single crystals in quartz. Sphalerite and pyrite are associated with the antimony minerals but are more common in the limestone adjacent to the vein. Pods of quartz and stibnite also occur some 40 feet southeast of the vein in the stoped area above the upper level; however no persistent controlling structure was noted.

Yellow and white residual antimony oxides are abundant in the zone of oxidation and leaching. Yellow antimony oxides also are abundant at some depths along fractures in the wall rock, having been transported and deposited during leaching of the vein. Pyrite has been oxidized to limonite. Green to blue melanterite coats some of the vein material.

Wall-rock alteration is slight.

The following table shows the results of analyses of three ore samples taken from this mine:

No.	Location	Description	Au oz.	Ag oz.	Sb %	Pb %	Zn %	Cu %	As %	Se %
96	Upper adit, southwest end of stope	Pods of stibnite and quartz in wall rock	None	2.34	31.70	....	0.65	0.04	Tr.	....
97	15-foot level	Vein	Tr.	3.60	1.60	....	0.95	0.05	None	....
98	Stockpile on dump of upper adit	Vein material	None	5.96	11.30	None	....	....	Tr.	0.006

De Soto mine

The De Soto mine is in sec. 22, T. 31 N., R. 34 E., in the Star mining district on the south side of Star Canyon, and on the east flank of the Humboldt Range (see USGS Imlay 15′ topographic quadrangle).

The property includes the Star Peak, Star Peak No. 2, Star Peak No. 3, Silver Reef, Woolcott, Hydenfeldt, De Soto, Tunnel, Treasure, and Rocky Cliff claims, all patented in 1904 (Mineral Survey No. 2078). There are two adits.

Thin-bedded limestone, tuffaceous sandstone, and thin, interbedded rhyolite flows of the Koipato(?) Formation are overlain by massive gray limestone of the Star Peak Formation. Both formations are Triassic in age, and generally strike N. 15° E. and dip 50° W.

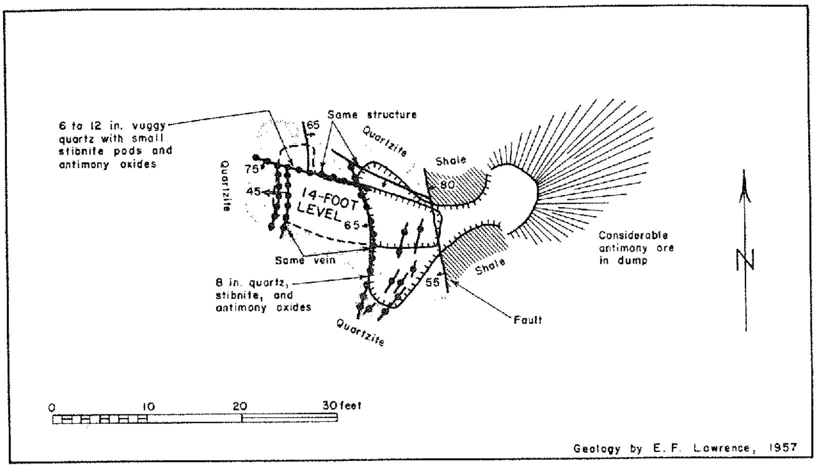

FIGURE 55. Geologic map of the workings on the Adriene No. 1 claim, Pershing County, Nevada.

A north-trending, steeply west-dipping vein cuts the rocks of the Koipato(?) Formation. As the vein extends into the overlying massive limestone of the Star Peak Formation, it breaks into numerous veinlets along bedding planes and fractures. Ore was mined along bedding plane shoots up to 100 feet from fractures that appear to have served as feeders for the ore-forming solutions. The vein (up to 48 inches wide) contains quartz, sphalerite, galena, chalcopyrite, pyrite, tetrahedrite, and minor jamesonite and stibnite. Stibnite occurs as fine acicular needles in quartz and in vugs, in amounts too small to mine. A grab sample assayed 1.32 percent antimony, 5.24 percent lead, 0.10

percent copper, traces of gold and zinc, and 8.78 ounces per ton silver.

The Sheba mine is in sec. 22, T. 31, N., R. 34 E., in the Star mining district on the south side of Star Canyon, and on the east flank of the Humboldt Range (see USGS Imlay 15′ topographic quadrangle), approximately 300 feet north of the De Soto mine.

It was a high-grade bonanza-producing antimonial silver ore (Ransome, 1909, p. 43) consisting of quartz, jamesonite, galena, sphalerite, pyrite, tetrahedrite, stephanite(?), and argentite(?). This mine is on the same vein as found at the De Soto. North of the Canyon this vein is offset to the west.

Willard (Loring) Mining District

Adriene mine

Other names	Louis Lay claim.
Location	Secs. 29 and 32, T. 28 N., R. 33 E.
Ownership	Rosal Mining and Land Co. (1957)
Production	15 tons antimony (metal).
Base map	USGS Oreana 15′ topographic quadrangle.

The Adriene mine is on the northwest flank of the West Humboldt Range. Twenty-one tons of antimony ore were produced during 1940 and 1941.

The property includes the Adriene claims Nos. 1, 2, and 3, located end to end along a northwest-trending ridge. The property is developed by two shallow shafts, several trenches, and an open cut and adit.

Interbedded green, gray, and yellow shale, pink to brown fine-grained sandstone, and quartzite, striking N. 40° W. and dipping 70° SW., crop out at the mine. The sandstone is composed of angular quartz grains with interstitial sericite and considerable tourmaline. Limestone is exposed on a knoll on the northeast side of the ridge, and probably is separated from the shale-standstone-quartzite sequence by a fault striking N. 45° W. and dipping 50° SW.

On the Adriene No. 1 claim, an open cut and short adit (14-foot level) explore two quartz-antimony veins in interbedded greenish-brown shale and brown quartzite (fig. 55). The main vein, 8 to 12 inches in width, strikes N. 5° W. and dips 45°–65° W. It terminates against a 6- to 12-inch vein striking N. 65° W. and dipping 70° S. Quartz-antimony stringers occur at the intersection of the two veins.

On the Adriene No. 2 claim, two shallow shafts follow 4- to 24-inch quartz-antimony veins striking N. 20° W. and dipping 70°–75° W. in brown quartzite with some interbedded gray shaly sandstone. The two shafts may expose the same vein, which may be a continuation of that on the Adriene No. 1 claim.

Quartz occurs as stringers and commonly is vuggy. Antimony occurs as pods and individual crystals of stibnite in the quartz. Much of the stibnite has been oxidized, leaving only small unoxidized kernels surrounded by yellow and white antimony oxides. Some of the antimony oxides have migrated and have been redeposited in the sandstone immediately adjacent to the veins.

The shale and sandstone wall rock show slight alteration of the clayey material and feldspar(?) grains to clay and sericite. Part of the alteration probably is the result of surface weathering. Two ore samples from this mine were analyzed. The antimony, gold, and silver values found are shown in the following table:

No.	Location	Description	Sb %	Se %	Au oz.	Ag oz.
64	Adriene No. 2 claim, northwest shaft, south end	8-inch vein of quartz, stibnite, and Sb oxides	10.46	......	Tr.	0.48
65	Adriene No. 2 claim, northwest shaft, north end	6-inch vein of quartz, stibnite, and Sb oxides	6.81	None	Tr.	0.50

Johnson-Heizer mine

Other names..................S. P., Ott Heizer mine.
Location..................Sec. 19, T. 28 N., R. 33 E.
Ownership..................Southern Pacific Railroad Co.
Production..................52 tons antimony (metal).
Base map..................USGS Oreana 15′ topographic quadrangle.

The Johnson-Heizer mine is in the Willard district, on the northwest flank of the West Humboldt Range. Ott Heizer, who held the property under lease from the Southern Pacific Railroad Co., first worked the mine in 1946. The following year, 157 tons of ore with an average 30 percent antimony content were shipped to Laredo, Texas. Later at least 300 tons of ore containing 5 to 10 percent antimony, were shipped to Toulon, Nevada.

The deposit is developed by a 264-foot inclined shaft (pl. 15) from which some 440 feet of drifting and considerable stoping were done; a number of trenches were made, and a shaft was sunk on the vein to the southeast. All workings except a few stopes and the southeastern shaft are accessible. Only a small amount of ore remains in the workings.

The main shaft was sunk on a vein striking N. 45° W. and dipping 60° SW. in gray, chocolate brown, and black shale with thin interbedded sandstone. At the second shaft about 200 feet to the southeast, the same vein is vertical and strikes N. 70° W. in gray shale and interbedded brown sandstone. Locally the shale is highly contorted and in places calcareous. At both shafts, the sedimentary rocks strike roughly parallel to the vein. The vein is cut but not offset by cross faults.

The vein varies in thickness from 6 to 25 inches, averaging 12 inches. Stibnite occurs as pods, veinlets, and fine hairlike crystals, commonly in quartz and calcite stringers. Pyrite is present along the edge of the quartz stringers. Ore is most abundant in a shoot that rakes S. 75° W., apparently controlled by the intersection of the vein with a favorable bed. Stibnite occurs more rarely as single crystals in quartz and calcite stringers along bedding planes in the contorted shale wall rock. The stibnite has been partially oxidized to yellow and white antimony oxides near the surface. Little clear-cut evidence of wall rock alteration by the mineralizing solutions exists; however, the shale along the vein does appear to be more talcose than elsewhere.

The following table gives the results of the analyses of three ore samples collected at the Johnson-Heizer mine:

No.	Description	Au oz.	Ag oz.	Sb %	Se %
69	231-foot level 6-inch vein	Tr.	0.44	9.56	None
70	108-foot level 18-inch vein	Tr.	0.54	1.77	......
71	43-foot level stringer zone	Tr.	0.50	2.05	......

Rosal mine

Other names .... Antimony King No. 1.
Location .... Sec. 30, T. 28 N., R. 33 E.
Ownership .... Rosal Land and Mining Co. (1957).
Base map .... USGS Oreana 15′ topographic quadrangle.

The Rosal mine is in the Willard district, on the northwest flank of the West Humboldt Range, approximately one mile south of the Johnson-Heizer mine.

Mine workings include two adits, two shallow shafts, and a number of open pits and trenches. Some stoping has been done in the main trench and the 28-foot winze from this trench. All workings are open.

Brown sandy quartzite, greenish-gray shale, and sandstone of Jurassic(?) Age, striking N. 30° W. and dipping 35°–50° W.,

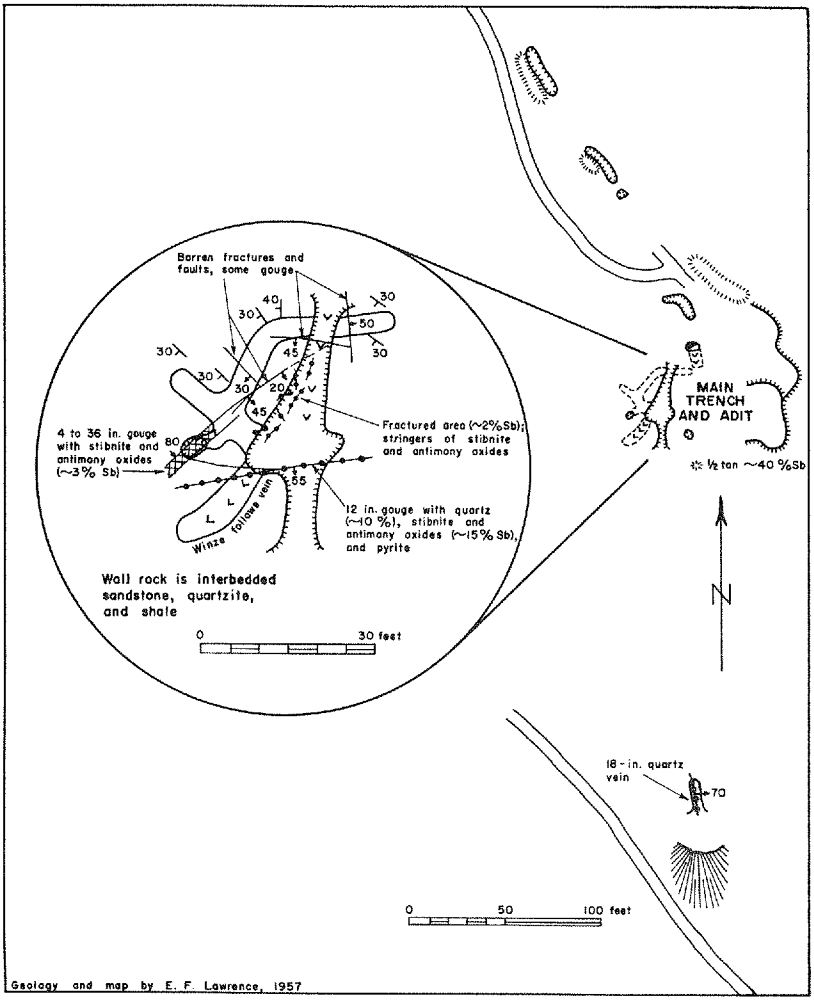

FIGURE 56. Geologic map of the Rosal mine, Pershing County, Nevada.

crop out at the mine. The sandstone is gradational into the quartzite. In places, the quartzite is thin-bedded and intercalated with the shale.

The workings explore two veins (fig. 56) in pink- to pale-red, fine-grained sandstone composed principally of quartz with a small amount of clay. One vein opened by the main adit strikes N. 40° E. and dips 80° E. It contains 4 inches of gouge along the hanging wall, and 32 inches of brecciated and unaltered sandstone. The gouge contains a few small pods and individual crystals of stibnite and abundant stains of antimony oxides. The other vein strikes N. 80° E. and dips 55° S., and is explored by the 28-foot winze from the main trench. It contains 12 inches of gouge with pyrite, approximately 10 percent quartz as stringers and doubly terminated crystals in vugs, and 10 to 20 percent antimony in the form of pods of stibnite and stains of antimony oxides. The southwest-raking intersection of the two veins has not been explored. Sandstone between the two veins is fractured. Stringers of stibnite, averaging half an inch in width, and antimony oxides fill the cracks. The entire fractured area contains an estimated 2 percent antimony, and the sandstone itself contains disseminated pyrite and stibnite.

Two prospect pits, 1,000 feet to the northwest, expose veinlets of quartz, stibnite, and antimony oxides, up to 6 inches thick, in quartzite and sandstone.

Along the veins, the wall rock commonly is sericitized, but locally is only argillized. The interstitial clayey minerals in the fine-grained sandstone have been sericitized. Some isotropic clay interstitial to the clay is associated with the antimony mineralization.

Near-surface stibnite is almost completely oxidized to multicolored (kermesite?) oxides, and pyrite has been completely removed by leaching. Thin-sections of the sandstone show numerous relict outlines of pyrite cubes and pyritohedrons and stibnite prisms with pyramidal faces. Leaching and in-place redeposition has flooded the groundmass with yellow antimony oxides. Brown iron oxide has been deposited along the vein walls and in the cavities left by the removal of the pyrite.

Less oxidation has taken place with depth. Yellow, green, brown, and red antimony oxides occur in smaller amounts in the deepest workings. There the pods of residual stibnite are larger, and the pyrite is relatively unaltered.

Analyses of two ore samples taken from this mine are given in the following table:

No.	Location	Description	Sb %	Se %	Au oz.	Ag oz.
66	Stockpile near main trench	Grab sample	14.48	......	Tr.	0.72
67	Main trench	12-inch vein quartz, pyrite, stibnite, Sb oxides	24.20	None	Tr.	0.54

Other Occurrences in Pershing County

Antimony Ike mine

Other names	Black Diamond, School Boy.
Location	Sec. 2, T. 30 N., R. 38 E.
Production	1 ton antimony ore.
Base map	USGS Sonoma Range 1° topographic quadrangle.

The Antimony Ike mine is in the Goldbanks mining district, on a hill east of the road extending southwest from the main Grass Valley road just south of Leach Hot Springs.

One ton of antimony ore was shipped in 1941. The deposit is developed by four trenches and a 77-foot inclined shaft with a 10-foot drift extending north from the bottom (fig. 57). The property consists of three claims, the Antimony Ike, Antimony Abe, and Gold Tom. Most of the workings are on the Antimony Ike claim.

The mine is on the contact of a stock of Jurassic(?) granite (or granodiorite) with the Carboniferous(?) Pumpernickel Formation (Ferguson, and others 1951). The Pumpernickel Formation is part of the upper plate of the Tobin thrust fault which is exposed 2,000 feet west of the mine and 200 feet topographically below it.

The granite is fine- to medium-grained, inequigranular and pink, weathering to white. It is composed of orthoclase and quartz with some plagioclase, hornblende, biotite, and rarer apatite. Much of the hornblende has been replaced by chlorite. The rock also contains up to 10 percent epidote, and one specimen contains considerable allanite.

The Pumpernickel Formation consists of greenstone, chert, and dark argillite, with interbedded limestone and clastic sedimentary rocks. The formation has been metamorphosed outward for a short distance from the granite contact. Garnet, epidote, and tourmaline are abundant.

A narrow quartz-antimony vein trending north and dipping 70° W. occurs near the contact (fig. 57), and can be traced for more than a thousand feet. In places it is on the contact, but more commonly is in the granite. Pods and individual crystals of stibnite commonly with quartz are scattered throughout the vein, together with associated pyrite and tetrahedrite. The stibnite has been oxidized to yellow and white oxides, the extent of oxidation decreasing with depth. Tetrahedrite in the shaft and drift has been oxidized to green copper carbonates.

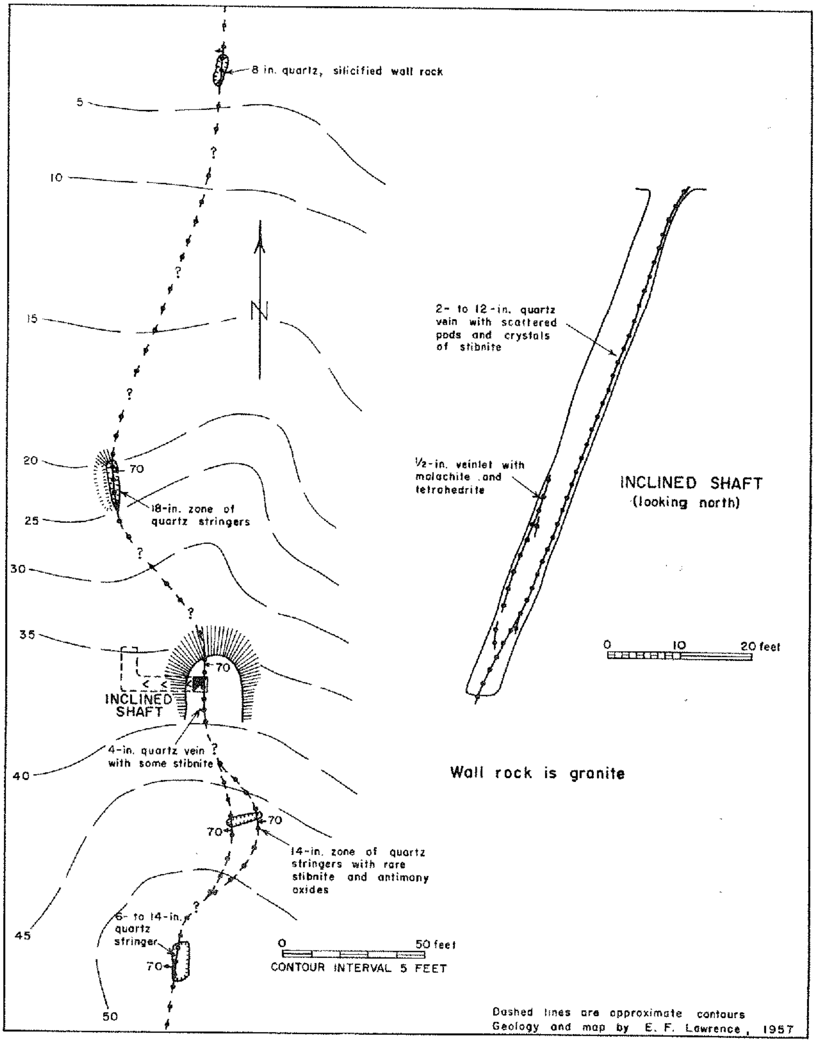

FIGURE 57. Sketch map of the Antimony Ike mine. Pershing County, Nevada.

The granite and metamorphic rocks found along the vein have been almost completely silicified, and also are sericitized, argillized, and contain some disseminated pyrite and stibnite. Plagioclase(?) grains in the granite have been completely sericitized, while the orthoclase shows only incipient alteration to kaolinite(?). A sample of ore taken from the vein at the bottom of the shaft (White, unpublished data, U. S. Geol. Survey) assayed 16.78 percent antimony, and 0.22 ounce of gold and 0.25 ounce of silver per ton.

Black Warrior mine

Other names	Ernst Black Warrior, Jackson Canyon.
Location	Sec. 35, T. 30 N., R. 34 E.
Ownership	C. A. Ernst, of Unionville (1959).
Production	83 tons antimony metal (known production).
Base map	USGS Unionville 15′ topographic quadrangle.

The Black Warrior mine is located in the Buena Vista mining district on the eastern flank of the Humboldt Range on the north side of Jackson Canyon, one mile due south of Unionville.

This deposit was reportedly worked in 1870. In 1916–1918, the stopes and dumps were reworked, and a jig used to concentrate the ore. Some $20,000 worth of antimony concentrates were shipped. In 1940 and 1941 some development work and mining were done. Screening the dump material produced a ton of 55 percent antimony concentrates which was shipped to Laredo, Texas.

The mine is developed by a number of adits and a shaft (fig. 58). The vein, exposed in the main (A) adit (fig. 59), has been extensively stoped; some of the stopes extend to surface. The other adits reveal only barren zones (figs. 60, 61).

Several veins cut the uppermost rhyolite flows of the Koipato Formation and the overlying basal conglomerate of the Triassic Star Peak Formation. Both formations dip gently north to northeast, but contain minor, northwest-trending folds which roughly parallel the veins. (The veins at the Bloody Canyon mine occur in the same stratigraphic units.) The rhyolite flows grade downward into banded rhyolite pyroclastic rocks. Interbedded limestones, siltstones, and sandstones of the Star Peak Formation occur above the basal conglomerate.

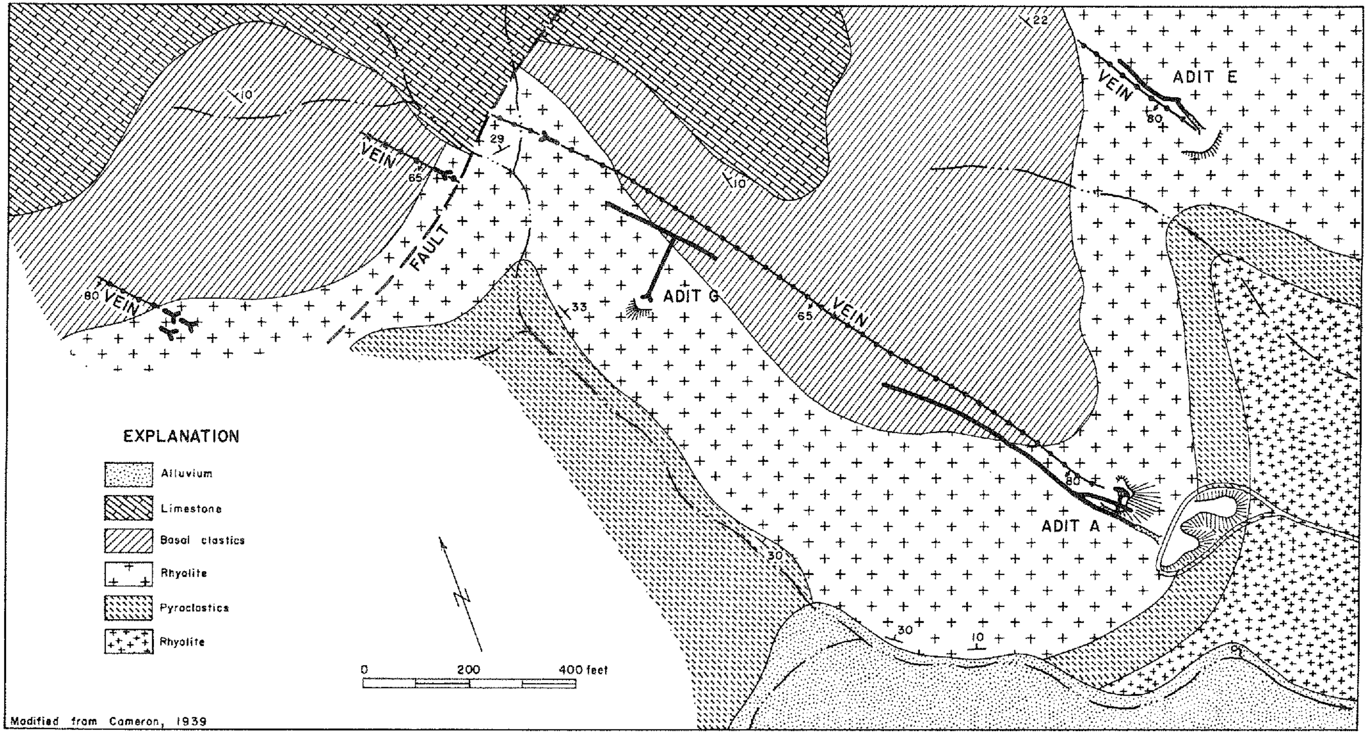

FIGURE 58. Geologic map of the Black Warrior mine, Pershing County, Nevada.

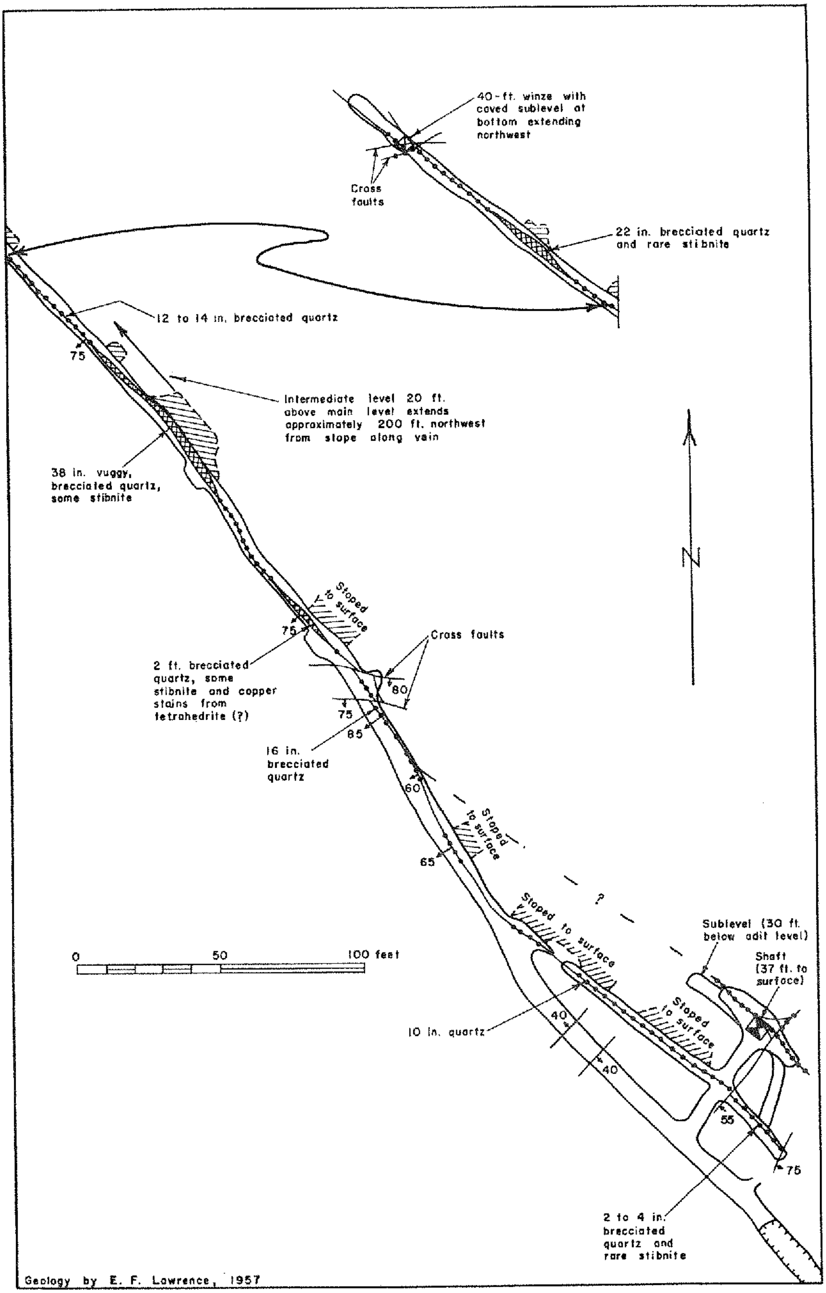

FIGURE 59. Geologic map of Adit A, Black Warrior mine, Pershing County, Nevada.

The veins strike N. 40° W. and dip 65° to 80° SW. They vary in width from 3 to 40 inches. The larger and higher grade ore bodies are in the rhyolite flows. The size and grade of the shoots apparently decrease as the veins extend upward into the basal conglomerate and downward into the rhyolite pyroclastic rocks. A number of cross faults offset the veins a few inches to several feet.

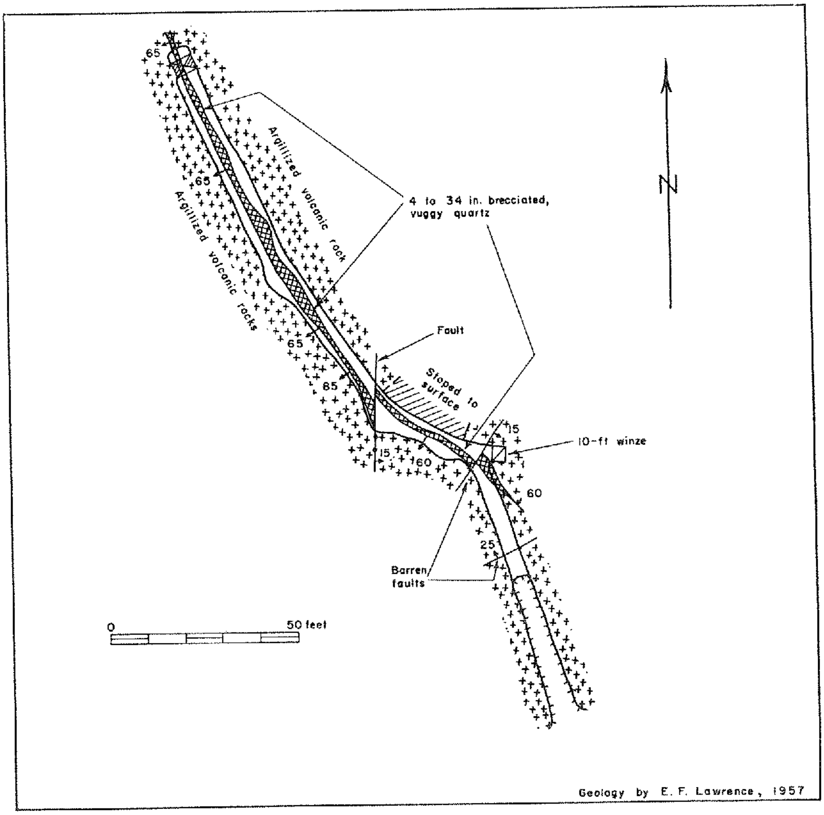

FIGURE 60. Geologic map of Adit E, Black Warrior mine, Pershing County, Nevada.

Vuggy to massive quartz is the most abundant vein mineral. Brecciated or granulated quartz recemented by younger quartz is common.

Stibnite occurs as small pods and streaks, and as individual hairlike crystals and irregular blebs in the quartz. Stibnated quartz is common in the numerous vugs. Small amounts of tetrahedrite, pyrite, and lesser amounts of resinous brown to yellow sphalerite are associated with the pods and streaks of stibnite. In adit A these are concentrated in lenticular ore shoots separated by thin, relatively barren vein material. Portions of the vein exposed in adit A average 3.8 percent antimony over an average width of 16.5 inches. This average grade is based on 47 channel

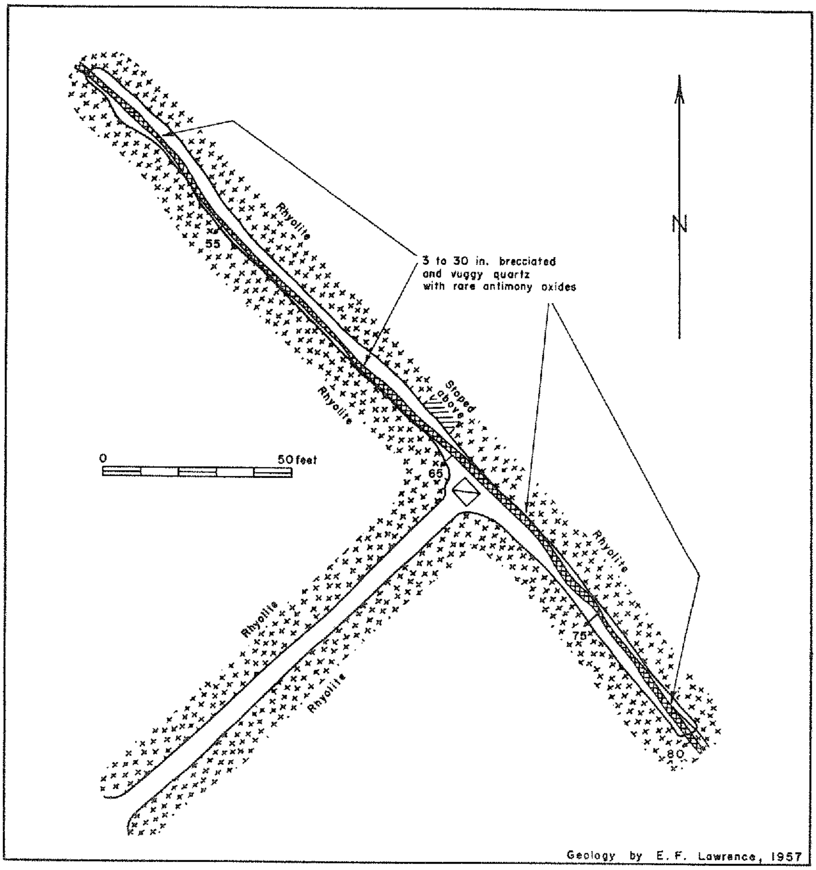

FIGURE 61. Geologic map of Adit G, Black Warrior mine, Pershing County, Nevada.

samples taken across the vein, generally at 10-foot intervals. (D. E. White, unpublished data, U. S. Geol. Survey). The other adits expose little ore.

Some of the stibnite has been oxidized to yellow and white antimony oxides. Powdery, yellow antimony oxides have migrated short distances and been deposited as coatings along cracks in the vein quartz and in the rhyolite wall rock. Yellow oxides also occur as hollow, cellular, thin-walled boxwork replacing stibnite. The white antimony oxide replacements are more massive, fibrous aggregates. Kermesite(?) is present in trace amounts. Pyrite commonly has been oxidized to limonite pseudomorphs, and the tetrahedrite has been partially converted to malachite and azurite.

The rhyolite wall rock has been altered adjacent to the veins. Many of the feldspar phenocrysts are replaced by sericite and the groundmass is argillized; the rock locally contains up to 50 percent kaolinite(?). Silicification also is common, with both chalcedony and quartz being introduced.

Bradley mine

Other names	Rye Patch No. 3.
Location	Sec. 24, T. 30 N., R. 33 E.
Production	1 ton antimony (metal).
Base map	USGS Unionville 15′ topographic quadrangle.

The Bradley mine is located on the north side of Panther Canyon in the west flank of the Humboldt Range.

Six tons of ore containing 18 percent antimony reportedly were produced in 1932; however, this ore may have come from the Panther Canyon mine. The prospect is developed by a short adit and winze now filled with water.

A shear zone, apparently the same as that at the Panther Canyon mine, follows a diabase dike. Thin-bedded limestone of the Star Peak Formation forms the northwest wall of the dike, and metavolcanics of the Weaver Rhyolite of the Koipato Formation form the southeast wall.

The shear zone strikes N. 30° E., dips 75° SE., and is 42 to 60 inches wide. It contains gouge, small stringers and pods of quartz, and small pods and streaks of stibnite with the quartz.

Oxidation and wall-rock alteration are similar to that found in the Panther Canyon mine, described below. Stibnite has been oxidized—yellow, powdery antimony oxides surrounding cores of stibnite, and white, fibrous antimony oxides occurring in cavities from which all stibnite has been leached. The rhyolite wall rock is argillized and the limestone is slightly argillized near the contact. The diabase has been partially argillized and locally completely silicified.

One ore sample, taken from a 4-inch vein in the adit, analyzed 17.47 percent antimony, and a trace of gold and 0.88 ounce per ton of silver.

Fencemaker mine

Other names	Fenstermaker, Lucky Lode, S & W.
Location	Sec. 31, T. 26 N., R. 37 E.
Ownership	Rosal Mining and Land Co., Lovelock (1960).
Production	1 ton antimony (metal).
Base map	USGS Sonoma Range 1° topographic quadrangle.

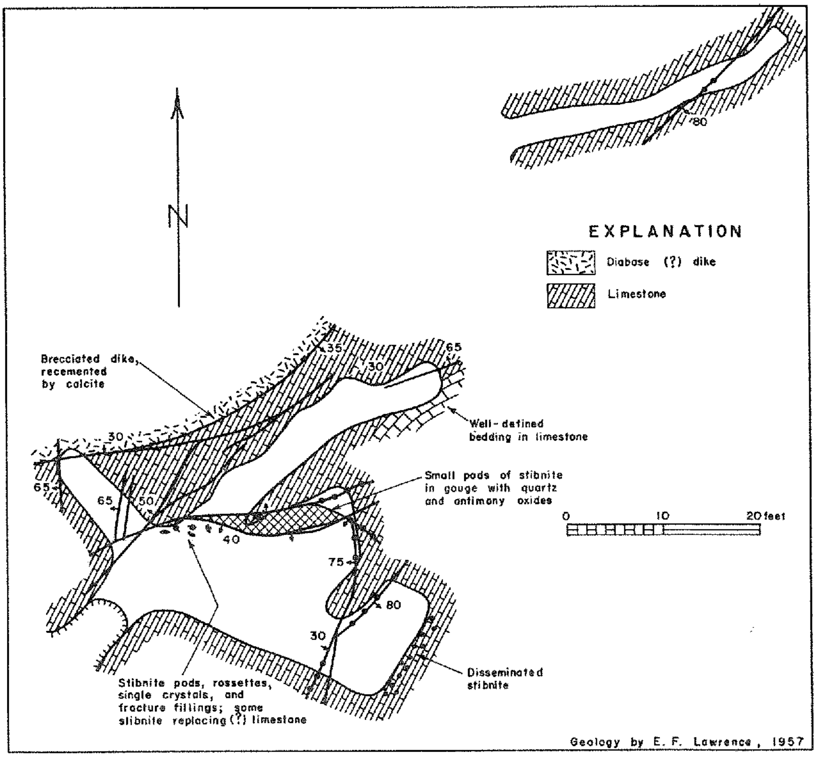

FIGURE 62. Geologic map of the Fencemaker mine, Pershing County, Nevada.

The Fencemaker mine is in the Table Mountain district at the north end of the Stillwater Range. Some antimony ore was shipped in the 1880's (Lincoln, 1923, p. 11). In 1940, two tons of ore averaging 50 percent antimony were shipped. The mine is developed by two adits totaling approximately 115 feet, an open cut, and numerous bulldozer cuts.

Triassic(?) limestone, dolomite, and shale are exposed in the vicinity of the mine. Northeast of the workings, a large body of diorite has intruded the sedimentary rocks. A narrow band of calc-silicate rocks occurs along this contact approximately 250 feet northeast of the mine. One hundred and fifty feet farther northeast, the diorite is stained red. Both the diorite and sedimentary rocks have been intruded by diabasic dikes.

The limestone strikes N. 30° E. and dips 30° E. at the mine. It is fine-grained and gray to tan in color, and contains up to 5 percent quartz as scattered grains and small pods. Brown, green, and yellow shale occurs stratigraphically above and below the limestone. The main workings are along a contact between this limestone and a dike. The dike is 12 to 30 inches in width and strikes N. 60° E. and dips 35° S. (fig. 62). This dike is highly brecciated, and has been recemented by calcite. Relict mineral-grain outlines, cleavages, and diabasic textures point to an original diabasic composition. Euhedral relict crystals have been completely replaced by silica and carbonate but retain the shape and cleavage of pyroxene and amphibole. The rock probably originally contained up to 35 percent ferromagnesian minerals. Other matter, lath-shaped relicts, now completely sericitized, appear to have been plagioclase grains. No contact metamorphism is discernible in the dike.

Numerous fractures and faults occur along the contact and in the limestone. Some contain small pods, streaks, rosettes, and individual crystals of stibnite. This sulfide is disseminated through the limestone in the end of the east cross cut from the main adit. Cinnabar also occurs as scattered blebs and single crystals. A small amount of yellow and white antimony oxides occur along the fractures. Kermesite (?) surrounds some pods of stibnite.

Rare argillic alteration shows along the fractures and faults; no silicification was noted.

A sample of ore collected at this mine assayed 3.03 percent antimony, and 4.66 ounces per ton of silver, with a trace of both gold and selenium.

Green Antimony mine

Other names	Silver Queen group, Wild Horse Antimony.
Location	Secs. 14 and 15, T. 25 N., R. 32 E.
Ownership	C. R. Coppin, Orville Canfield, and Charles Sansom (1957).
Production	46 tons antimony (metal).
Base map	USGS Lovelock 15′ topographic quadrangle.

The Green mine in on the east flank of the West Humboldt Range, in the canyon south of Wildhorse Canyon.

First located during World War I, the deposit later was relocated by Averill and Frank Green. A small quantity of ore

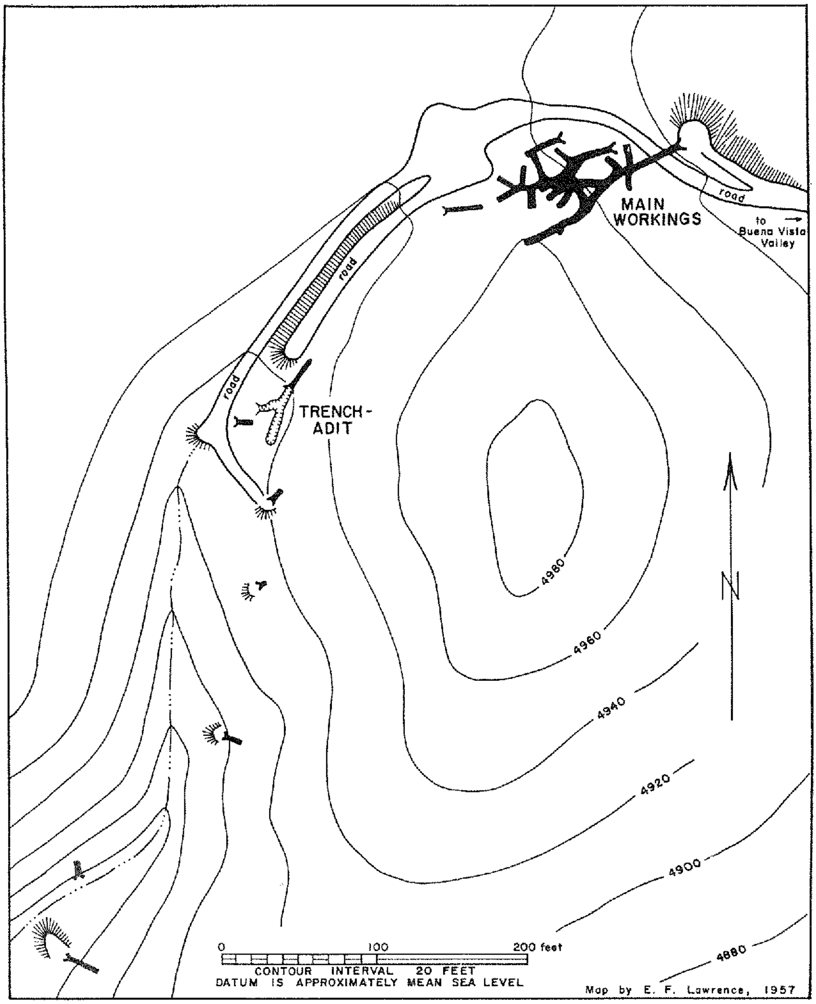

FIGURE 63. Map of the Green Antimony mine, Pershing County, Nevada.

was shipped in 1918 from the property. Vanderburg (1936, p. 50) mentioned that the mine was operated for three years by the Green brothers, and that 30 tons of ore averaging $60 per ton had been stockpiled.

Four adits (fig. 63), totaling approximately 410 feet, explore a mineralized fault zone at the main workings. Some stoping has been done. Two hundred feet southwest of these workings an open trench and adit 60 feet long expose good ore on the same zone. Six other short adits explore structures farther to the southwest.

Greenish-gray to gray fine-grained diorite crops out over the entire mine area. The diorite is composed of plagioclase, hornblende, and augite with small amounts of magnetite, biotite, actinolite, apatite, scapolite, and sphene. The plagioclase has a composition of $Ab_{70}An_{30}$, and occurs as short laths, which in places have a matted texture. The hornblende and augite are euhedral to subhedral, while the actinolite and biotite commonly are anhedral. The rock contains up to 3 percent apatite, some of which is in the form of moderately large crystals. Magnetite commonly is associated with the larger concentrations of apatite.

What appears to be a dike of diorite aplite is intruded along the footwall of the fault zone. Unfortunately, this rock is so altered that its appearance and field relations are obscure.

Limestone is reported (private report, 1954) in contact with the diorite a few hundred feet north of the main workings, but none was found during this field examination. Possibly some of the more altered diorite, which superficially resembles limestone and effervesces when tested with hydrochloric acid, was mistaken for limestone.

In the main (north) workings (pl. 16), the fault zone is up to 20 feet wide, strikes N. 65° E., and dips 50°–60° SE. Several cross faults, striking N. 15° W. and dipping 70° E., offset the fault zone one to two feet. To the southwest, in the trench-adit the fault zone is narrower, strikes N. 40° E., and dips 65° SE. Here, and farther to the southwest, a number of other cross faults, also trending north-northwest, offset the fault zone distances up to several hundred feet. South of the trench-adit the relatively narrow, well-defined fault zone changes to a much wider, less well-defined complex zone containing a number of individual faults. Six short adits to the south explore some of these faults (fig. 63).

Antimony minerals are most abundant in the northeastern part of the fault zone (pl. 16), but do occur more rarely to the southwest. Pods, streaks, and individual crystals of jamesonite are present. Some of the best mineralized ore appears to be near the intersection of the main zone and cross faults. One ore shoot was probably half a foot wide, 25 feet long, and 6 feet high.

Much of the jamesonite, especially near the surface, has been oxidized to bindheimite and other antimony oxides. Locally, halos of bindheimite and other antimony oxides are found around fresh jamesonite.

Quartz, pyrite, gypsum, and limonite pseudomorphs after pyrite commonly occur in the fault zone and wall rock with the antimony minerals. Up to 7 feet of gouge is found in the break.

The diorite along the fault zone is highly altered, in places, over widths of 200 feet. Away from the fault, the only alteration seen in the diorite consists of chloritization of the ferromagnesian minerals and minor incipient argillization of the plagioclase. In the more weakly mineralized portions of the fault zone the groundmass of the chloritized diorite is flooded by carbonates, and the plagioclase laths have been partially to completely argillized. Along the veins, the wall rock is almost completely sericitized and locally silicified; commonly, some carbonates remain but the chlorite is gone. The diorite-aplite dike shows similar argillization and sericitization.

The chloritization may have been deuteric, and thus could have been pre-antimony mineralization. However, it may represent a less intensely altered outer zone of hydrothermal alteration. The spatial relations of the other types strongly suggest alteration by mineralizing solutions.

The superimposed effects of surface weathering have obscured the picture. Kaolinite(?), yellow antimony oxide stains, brown limonite stains, and gypsum veinlets and masses result from this weathering.

Antimony, gold, and silver values found in four ore samples taken at this mine are given in the following table:

No.	Location	Description	Sb %	Au oz.	Ag oz.
53	Main workings, lower adit, just west of raises	Pod of jamesonite along hanging wall of dike	17.20	Tr.	15.70
54	Main workings, west end middle adit	8-inch vein quartz, jamesonite, and Sb oxides	13.06	Tr.	18.68
55	Trench-adit, north end	30-inch gouge zone containing jamesonite, bindheimite, and other Sb oxides	17.14	Tr.	28.0
56	Stockpile, main workings	Grab sample	33.18	Tr.	18.42

King George mine

The King George (Cinnabar City) mine is located in sec. 1, T.

28 N., R. 34 E., on the divide between American Canyon and Spring Valley 2 miles south of Fitting (see USGS Unionville 15′ topographic quadrangle). In 1958 it was being operated by Metals Exploration Co. Bailey and Phoenix (1944, p. 178) described the geology of this deposit. Antimony occurs as stibnite and various oxides scattered through the ore, associated with cinnabar, native mercury, calomel, and quartz.

Little Tungsten mine

Other names	Oreana Tungsten.
Location	Sec. 3, T. 29 N., R. 33 E.
Ownership	Rare Metals Corp.
Production	None.
Base map	USGS Oreana 15′ topographic quadrangle.

The Little Tungsten mine is on the western flank of the Humboldt Range south of Rocky Canyon.

Native antimony occurs associated with scheelite and beryl in a pegmatite body 2,000 feet long and 1 to 5 feet wide. The pegmatite consists principally of quartz, oligoclase, albite, and phlogopite. Quartz and fluorite are common in adjacent smaller pegmatitic bodies. The geologic setting has been described by Kerr (1938) and Olson (1960).

Native antimony is rare but occurs as small irregular pods and prismatic crystals on quartz and feldspar. It commonly is oxidized to fibrous or powdery, yellow and white antimony oxides.

McCrillis prospect

The McCrillis prospect is in sec. 16, T. 30 N., R. 34 E., on the east flank of the Humboldt Range, approximately 2 miles northwest of Unionville in the saddle above Congress Canyon (see USGS Unionville 15′ topographic quadrangle). A 1- to 2-inch vein contains calcite and quartz, and minor galena and yellow antimony oxides. The little stibnite that occurred in the vein has been removed by sampling. Samples taken by Dave McCrillis assayed 2 percent antimony, and 0.06 ounce of gold and 1.52 ounces of silver per ton.

Muttleberry Canyon mine

Other names	Old Tiger, Case Card.
Location	Sec. 2, T. 26 N., R. 32 E.
Ownership	Warren B. Richardson and Frank Margrave, of Reno, (1957).
Base map	USGS Lovelock 15′ topographic quadrangle.

The Muttleberry Canyon mine is in the Muttleberry district on the northwest side of Muttleberry Canyon on the west flank of the West Humboldt Range.

Reportedly (Vanderburg, 1936, p. 23) 40 cars of silver-lead-antimony ore were shipped from 1910 to 1919. In 1919, a small Gibson mill was operated briefly and then dismantled (Vanderburg, 1936).

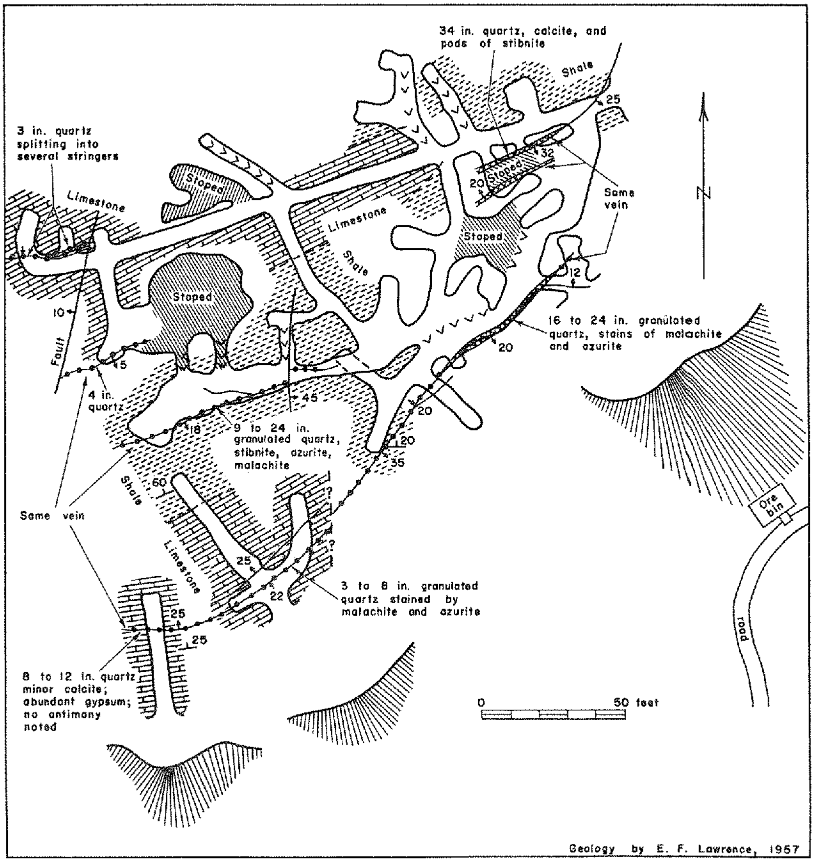

FIGURE 64. Geologic map of the Muttleberry Canyon mine, Pershing County, Nevada.

Openings include four adits (fig. 64). All mining was done from the rather extensive, interconnected workings of the upper two adits.

Massive to thin-bedded, gray to pale-brown, Mesozoic limestone and interbedded shale, generally striking N. 65° E. and dipping 50°–60° N., crop out at the mine. These beds are overlain by Tertiary volcanics. The mine area is in the lower plate of a thrust fault of large magnitude which has broken up the limestone and shale in preparation for deposition of the ore.

The vein generally strikes N. 70° E. and dips 30° S. to 20° N., although several substantial variations in dip occur in the mine area. It varies from 4 to 24 inches in width and locally divides into stringers that form a sheeted zone up to 48 inches wide. Pods, streaks, and single crystals of stibnite occur in granulated, milky vein quartz, and calcite. One 9- to 24-inch pod contained approximately 12 percent stibnite. Galena, tetrahedrite, pyrite, and occasional traces of sphalerite occur in the quartz and calcite. Tetrahedrite occurs as pods and veinlets with associated small blebs and crystals of galena. Pyrite occurs as small masses and as individual crystals throughout the vein.

Tetrahedrite has been partially oxidized to malachite and azurite; these minerals occur as rims around kernels of the sulfide. Brown and yellow antimony oxides occur as rims around stibnite, and also form pulverulent coatings on tetrahedrite, stibnite, and quartz. The red oxysulfide (kermesite?) develops on cleavage planes in stibnite.

The wall rock shows very little alteration, although considerable gypsum is present.

The following table gives analyses of four ore samples from this mine:

No.	Location	Description	Sb %	Au oz.	Ag oz.
79	West adit	10-inch vein	Tr.	Tr.	3.36
80	South adit, west drift	18-inch vein	3.42	None	38.76
81	Stoped area	34-inch vein	7.42	Tr.	10.60
82	Stockpile	Vein material	21.87	Tr.	18.20

Nevada-Massachusetts Co. mine

The ore at the Nevada-Massachusetts Co. mine (sec. 35, T. 34 N., R. 34 E.) at Mill City in the Eugene Mountains contained a small amount of antimony (Aune, unpublished data, U. S. Bureau of Mines). However, other analyses of tungsten concentrates gave less than 0.001 percent antimony (oral communication, 1957, Eldridge Nash, General Manager, Nevada-Massachusetts Co. mine). Small pods of jamesonite occur rarely in quartz stringers.*

*The Nevada-Massachusetts Co. mine, formerly one of the world's largest producers of tungsten, was closed in 1962. (Editors).

Ore Drag mine

Other names..........Tungsten No. 14, Peacock, Swackhamer.
Location..........Sec. 14, T. 31 N., R. 40 E.
Ownership..........Mark Durfee, of Battle Mountain (1957).
Production..........Approximately 16 tons antimony (metal).
Base map..........USGS Sonoma Range 1° topographic quardangle.

The Ore Drag mine is in the Aldrich mining district on the south side of Lee Canyon on the east slope of the north end of the Tobin Range. In 1940(?) approximately 26 tons of ore averaging 62 percent antimony were produced. Later, scheelite was mined from several nearby trenches and adits.

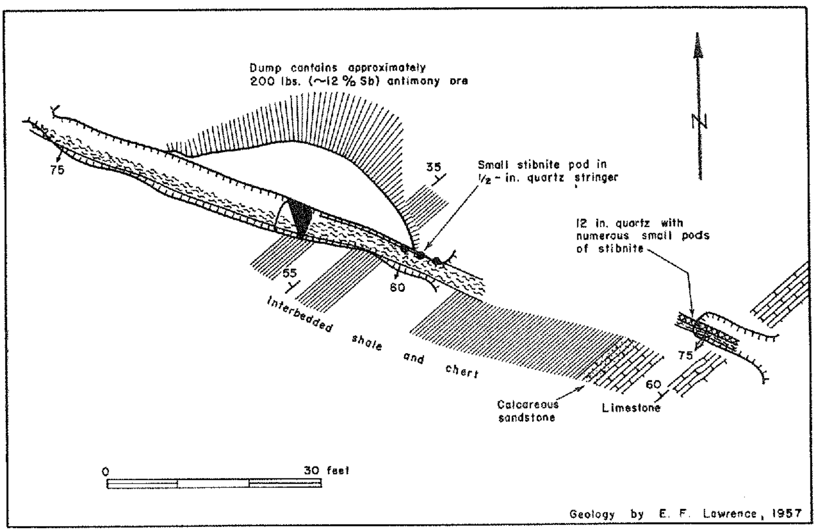

FIGURE 65. Geologic map of antimony workings at the Ore Drag mine, Pershing County, Nevada.

The stibnite ore was mined from two trenches and a shaft (now caved) in the bottom of the larger trench (fig. 65). Two other trenches to the southwest were opened for tungsten.

The Triassic Panther Canyon Formation (Ferguson and others, 1952) crops out at the mine. Gray siliceous limestone is overlain by brown, hard, calcareous sandstone, which in turn is overlain by interbedded brown shale and chert. These sedimentary rocks strike N. 50° E. and dip 35°–60° NW.

The mine lies between two north-trending faults. The ore is in a shear zone 20 to 40 inches wide striking N. 70° W. and dipping 60°–75° S. (fig. 65). Small- to medium-sized pods and streaks of stibnite occur in stringers and as masses of quartz in the shear zone. In the lower trench stibnite occurs in a 12-inch quartz vein as small pods and bladed crystals in vugs. Scheelite is associated with the stibnite. One sample of antimony ore shows numerous grains of scheelite under an ultraviolet lamp.

Yellow and white antimony oxides are common both as coatings on grains and kernels of stibnite, and as pulverulent material along the quartz vein and fault plane. Red oxysulfide (kermesite?) was noted along the cleavage planes in bladed stibnite. Except for silicification, wall-rock alteration is minor.

The antimony and other values found in two samples of ore from this mine are shown in the following table:

No.	Location	Description	Se %	Sb %	Au oz.	Ag oz.
91	Dump at main trench	Vein material	None	9.80	None	0.48
92	East end, main trench	Stibnite in quartz stringer	......	3.82	None	0.36

Panther Canyon mine

Other names........ Rye Patch Antimony, Imlay (?).
Location........ Sec. 24, T. 30 N., R. 33 E.
Ownership........ Louis Martin, of Lovelock, and Wayne Martin, of Reno (1957).
Production........ 1 ton antimony (metal).
Base map........ USGS Unionville 15′ topographic quadrangle.

The Panther Canyon mine is on a hill approximately one-fourth of a mile southwest of the Louis Martin cabin at the end of the road up Panther Canyon on the west flank of the Humboldt Range.

Four tons of ore containing 28 percent antimony reportedly were mined during 1940–1941 (White, unpublished data, U. S. Geol. Survey). In 1952, several tons of high-grade antimony ore were shipped to Reno for a test of an electrolytic concentration process which proved unsuccessful.

The mine is developed by two adits and an open cut which connects with the upper adit (fig. 66); the workings are open.

The mine is located on a diabase dike which has intruded a fault between the Weaver Rhyolite of the Koipatoan Series and the Star Peak Formation. Jenney (1935, p. 47) described the geology of the central Humboldt Range.

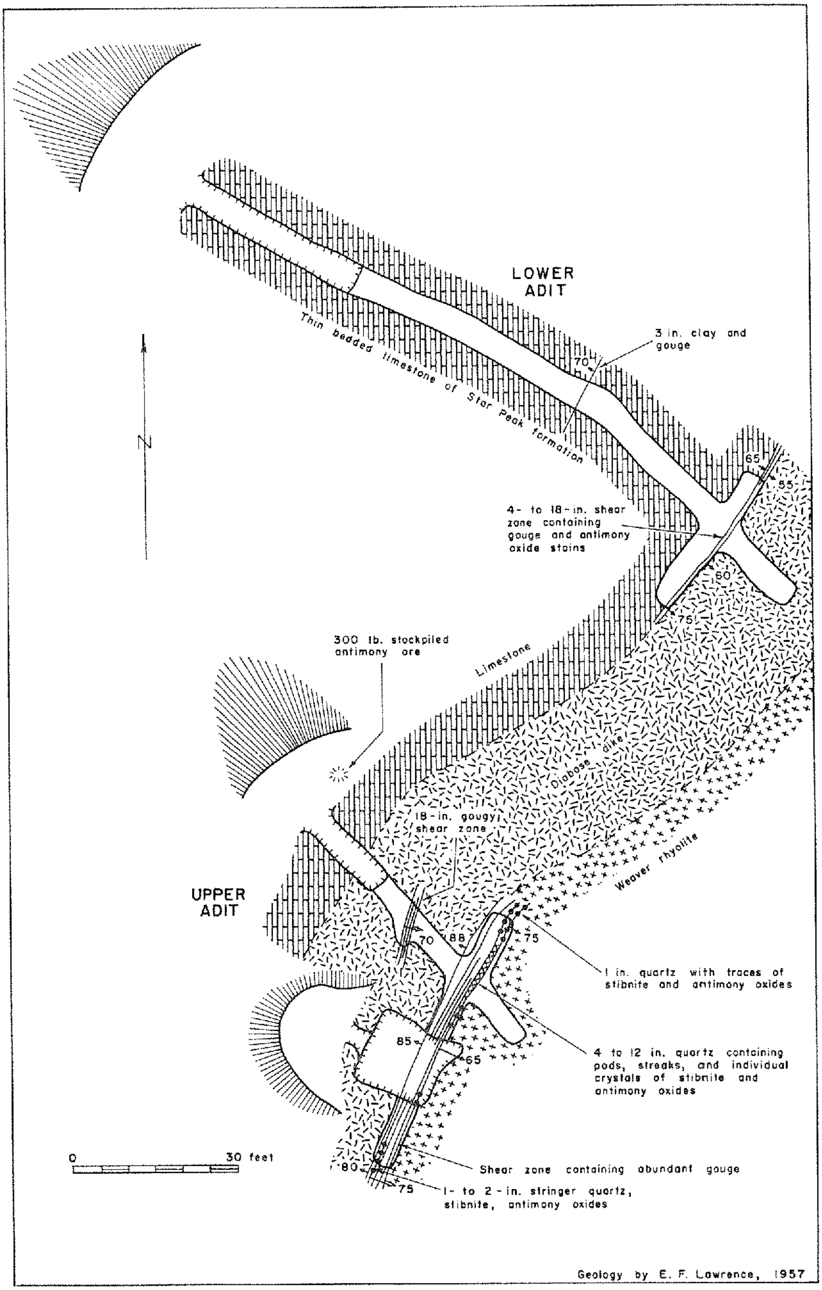

FIGURE 66. Geologic map of the Panther Canyon mine, Pershing County, Nevada.

The tan diabase dike, striking N. 30° E. and dipping 65°–75° SE., is about 30 feet thick, and apparently is the same one that crops out at the Rye Patch mine in the next canyon to the south. The dike is composed of labradorite, pigeonite, olivine, iddingsite, and chlorite. In places it has been completely silicified, sericitized, and contains abundant carbonate.

The hanging wall, southeast side of the dike, is a series of rhyolitic rocks. The footwall is composed of thin-bedded, crystalline, gray limestones. Both walls of the dike have been altered; the rhyolite shows considerable argillization, while the limestone is only slightly altered.

In the upper adit, a shear zone 24 to 42 inches in width strikes N. 25° E. and dips 75° SE., and occurs along the hanging wall of the dike. In the lower adit, a shear zone 6 to 18 inches in width strikes N. 35° E. and dips 55°–75° SE., following the footwall of the dike. The lower adit does not expose the hanging wall.

Stibnite occurs as pods, streaks, and individual crystals in quartz pods, veins, and stringers in both shear zones. Most commonly, it has been oxidized to yellow, powdery antimony oxides. Less commonly, white, fibrous antimony oxides occur in cavities from which the stibnite has been completely leached. Antimony, silver, and gold values found in four ore samples from this mine are shown in the following table:

No.	Location	Description	Sb %	Se %	Au oz.	Ag oz.
14	Upper adit, SW drift	Quartz-stibnite stringer	41.80	......	None	0.72
15	Upper adit, NE drift	Quartz-stibnite pod	11.80	......	None	0.40
16	Stockpile, upper adit	Vein material	21.26	None	Tr.	1.04
17	Upper adit, surface	Vein material	23.07	......	None	0.22

Other occurrences in Panther Canyon

Betty La Verne group. Argentiferous stibnite with a high silver content reportedly occurs at the Betty La Verne group. This occurrence probably is in Panther Canyon.

Rose mine. The vein reportedly is 5 feet wide and contains some pods of stibnite. This occurrence probably is in Panther Canyon.

Polkinghorne prospect

Other names	Hot prospect.
Location	Sec. 25 (?), T. 27 N., R. 38 E.
Ownership	Rene and Fern Amat.
Production	Minor.
Base map	USGS Sonoma Range 1° topographic quadrangle.

The Polkinghorne prospect is located on the southwest flank of the Tobin Range, several hundred feet north of an airway beacon and 3 air miles southeast of the Miller (Polkinghorne) Ranch.

A number of shallow pits and trenches were made.

Limestone and dolomite of the Middle Triassic Natchez Pass Formation (Muller and others, 1951) crop out at the mine. These rocks generally strike north and dip gently to the west. Tertiary rhyolite and andesite overlie the limestone and dolomite. Small Tertiary andesitic and basaltic intrusive bodies are common to the east and north, where they are closely associated with mercury deposits. The mine is in the lower plate of the Mount Tobin thrust fault.

Antimony-mercury-barium mineralization occurs along a fault which strikes N. 20° E. and dips 85° W. At least one parallel fault is present a few hundred feet to the west. Barite occurs as veinlets, isolated pods, and masses replacing the limestone. Some silicification accompanies the barite. Numerous small grains and crystals of cinnabar are present both in the barite and in the limestone adjoining the fault. In some cases cinnabar crystals are perched on yellow antimony oxide in cavities formed by leaching. A sample taken in 1942 assayed 53.3 percent antimony, 0.03 percent arsenic, 0.05 percent lead, 0.05 percent selenium, a trace of copper, and no zinc (Fred Dakin, private report, 1942).

Stibnite occurs as sporadic pods along the fault. This sulfide occurs as fine-grained blades up to an inch long or in radiating clusters. Commonly barite encloses masses or tiny blades of stibnite. In one specimen a nucleus of cinnabar is enclosed by a radiating cluster of bladed stibnite. Another specimen shows a crystal of stibnite almost completely replaced by cinnabar.

The stibnite has been completely or partially oxidized to yellow and white antimony oxides. These oxides are present as powdery coatings, both in the cavities formed by leaching of the stibnite, and along fractures in the limestone wall rock. A red oxysulfide (kermesite?) is common as small pods and coatings along cleavage planes in stibnite.

The stibnite and some of the cinnabar apparently were deposited earlier than the barite. Some of the cinnabar is definitely younger than the stibnite, and appears to have been deposited after the oxidation of the stibnite. Possibly this late cinnabar was deposited by solutions that oxidized the stibnite.

Rochester district

The Rochester district is on the western flank of the Humboldt Range, where it abuts against the West Humboldt Range in T.

28 N., R. 34 E. (see USGS Unionville 15′ topographic quadrangle). Although no antimony has been produced in the district, tetrahedrite, jamesonite, and bindheimite occur in the silver veins (Knopf, 1924, p. 54). Jamesonite occurs in a narrow fissure in aplite, associated with sphalerite and galena in quartz. Most of the silver veins have tetrahedrite as the primary silver-bearing mineral. Usually it has been oxidized, and supergene sooty argentite has formed. Pyrite, sphalerite, tetrahedrite, and chalcopyrite are the only primary minerals found. Some silver veins contain tourmaline but the most productive do not. Knopf believed the mineralization is genetically related to the aplite dikes in the area.

Rosebud mining district

Aune (unpublished data, U. S. Bureau of Mines) reported that antimony occurs in the Rosebud district T. 33 N., R. 30 E. Ransome (1909, p. 25–27) has described the geology of the Rosebud district in some detail, but does not mention the presence of antimony minerals. A search of the dumps and mine made by the writer failed to disclose antimony minerals, and miners familiar with the district did not know of any.

Seven Troughs mining district

The Seven Troughs mining district is on the east slope of the Seven Troughs Range, 30 miles northwest of Lovelock. Over $2.5 million worth of gold and silver, plus a small amount of lead and copper have been produced.

Rhyolite and andesite volcanic rocks are cut by north-trending fissure veins, which commonly follow basalt dikes and contain finely to coarsely brecciated wall rock, sugary quartz, native gold, silver, some pyrite, and rare chalcopyrite. Ransome (1909, p. 24) stated that:

> "Stibnite occurs in friable lenticular masses of considerable size in soft crushed basalt in the Chadbourne lease, and is said to have been found also in the Reagan lease. It does not however appear to have any intimate connection with rich ore."

No stibnite was found on the Chadbourne claims during this study; however, a small amount was found in the Reagan mine. The sulfide occurs as fine acicular crystals less than a fourth of an inch in length in vugs in a quartz vein. This parallels a basalt dike 18 to 24 inches wide striking N. 20° E. and dipping 70° NW. Vein material consists chiefly of silicified rhyolite fragments recemented by quartz. The rhyolite wall rock has been argillized. The Chadbourne claims and Reagan mine are near a contact between rhyolite and andesite.

Silver Goddess Annex mine

Antimony reportedly (White, unpublished data, U. S. Geol. Survey) occurred at the Silver Goddess Annex mine owned by E. Cramer, of Lovelock. This occurrence could not be located or verified.

Sutherland Antimony mine

Other names	Reid, Salvation, Kermesite, Thies-Hutchins.
Location	Sec. 15, T. 27 N., R. 33 E.
Ownership	National Lead Co. (St. Louis Smelting and Refining Co.)
Production	875 tons antimony (metal).
Base map	USGS Lovelock 15′ topographic quadrangle.

The Sutherland mine is located in the Black Knob district just east of Coal Canyon in the West Humboldt Range.

Blake (1885, p. 643) stated: "Antimony ore also is found in the Relief District, Humboldt County, about 18 miles east of Lovelock's station, on the Central Pacific Railroad . . . and has yielded considerable ore from the croppings downward to a depth of a few feet." Up to 1914, 3,000 tons of ore averaging 20 percent antimony were produced. Schrader (unpublished data, U. S. Geol. Survey) reported that the Reid (Sutherland) mine, owned by John T. Reid, was the principal producer of antimony in Nevada during World War I, notably during 1915 and 1916, (no production figures available) when the mine was worked by the Magnolia Metals Co., of New York. During 1917 and 1918, 500 tons of ore with from 25 to 44 percent antimony content were produced. Schrader reported considerable reserves, 100 tons of 20 percent ore being blocked out. During World War I some concentrates were made in a small Joplin-type jig mill on the Humboldt River and shipped to the Nickols-Layng Chemical Company of San Francisco (Vanderburg, 1936, p. 13). Later a small but unsuccessful furnace was erected at the mine to treat the ore (White, unpublished data, U. S. Geol. Survey).

In 1948–1949 approximately 300 tons of ore containing 33 percent antimony were produced by a lessee, John M. Heizer. At the same time approximately 700 tons of 5 to 10 percent-grade

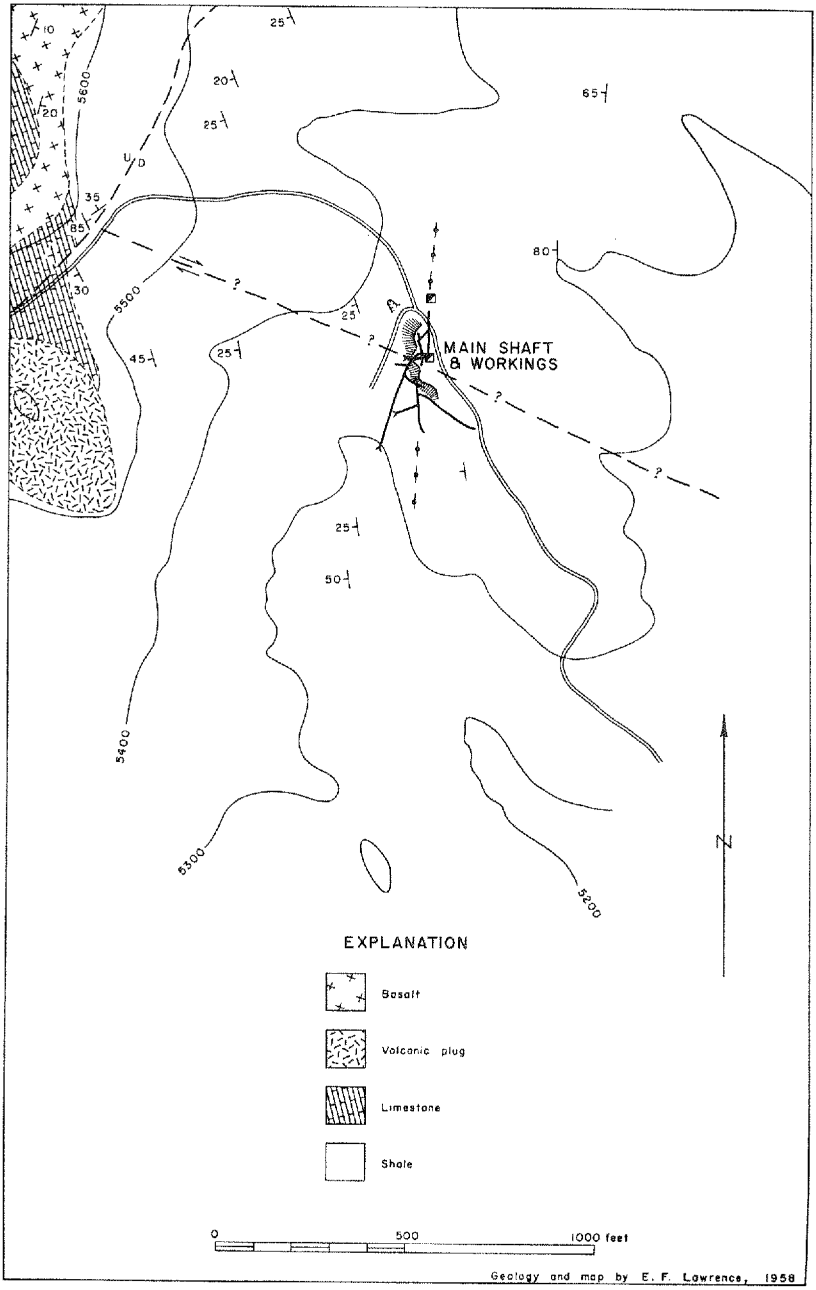

FIGURE 67. Geologic map of the Sutherland mine and vicinity, Pershing County, Nevada.

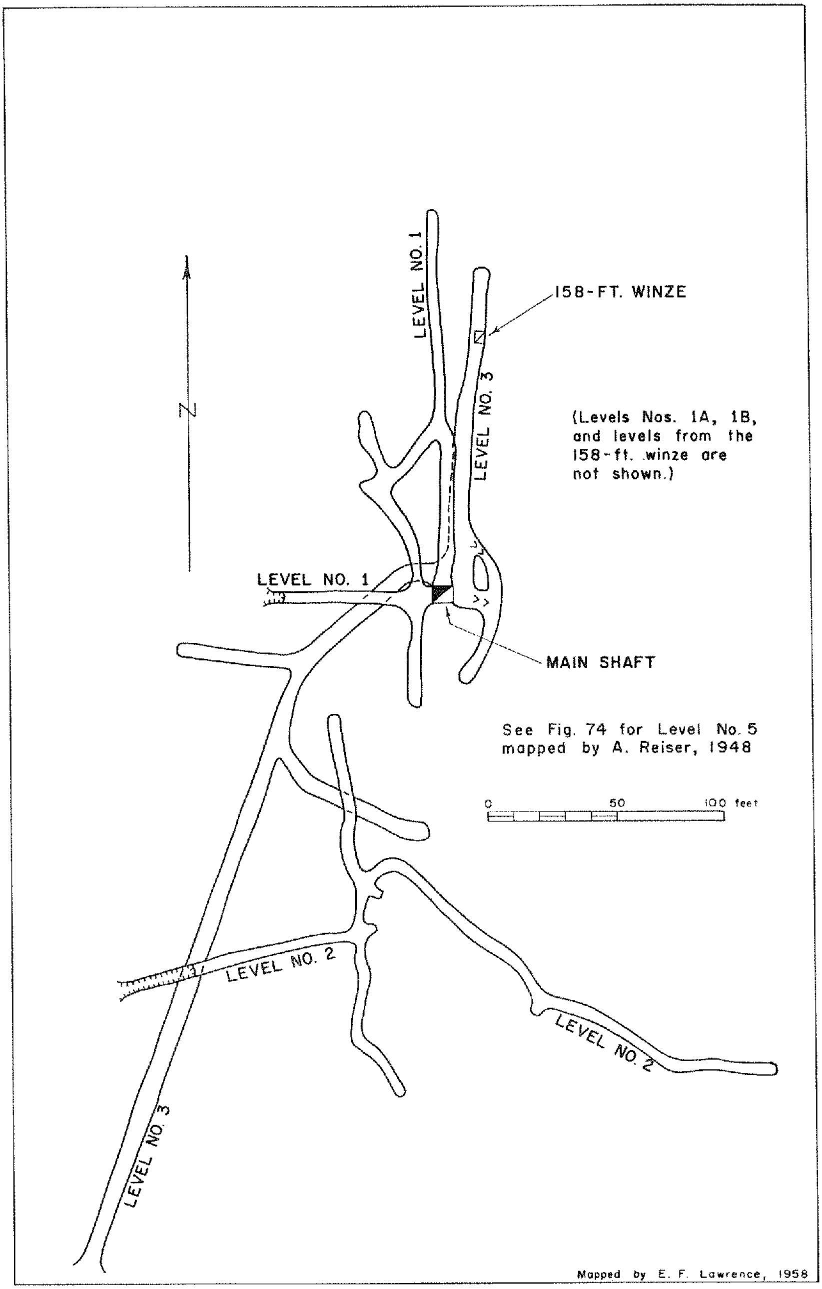

FIGURE 68. Map of workings of the Sutherland mine, Pershing County, Nevada. (See cross section, fig. 69.)

ore were sorted and used as fill in the stopes. This lower grade ore was mined from the area along the winze below the third level where the ore shoot was 2 feet wide and 56 feet long (R. B. Spitzer, private report, 1949).

Workings consist of three adits, a 220-foot shaft with a number of levels, and a 158-foot inclined winze totaling approximately 2,000 feet. (figs. 67–74). North of the main workings, the deposit has been explored by a 24-foot shaft, south of which is a short adit. Most of the workings are accessible.

Upper Triassic shales and interbedded calcareous shale, sandstone, and limestone crop out and are exposed in the workings (fig. 68). The rocks strike northwest to northeast and dip 25°–80° W. (averaging 40° W.). The shale is thin bedded and gray to buff in color, locally tinted pale purple to yellow and is partially sericitic; some layers are calcareous. Locally, the shale is highly contorted, especially against the harder, more competent sandstone. Thin (2- to 24-inch) beds of pink to brown sandstone and bluish-gray limestone are interbedded with the shale. At the surface, differential erosion has resulted in ribs of hard sandstone protruding above the softer, interbedded shale. A fairly thick sequence of limestone crops out in the saddle northwest of the mine.

Dense brownish-black to dark-brown Tertiary basalt flows, up to 30 feet in thickness, crop out on the ridges north and south of the mine. These flows strike northeast and dip 15°–25° SE. They are somewhat porphyritic near their tops and vesicular near their bottoms.

Two volcanic plugs form prominent knobs 0.2–0.3 of a mile west of the mine. The original texture and composition of the plugs is almost completely obscured by silicification. The rock may have been porphyritic in part.

The mine is on the western limb of an anticline plunging to to the northwest. Just south of the shaft a high-angle cross fault trending northwest apparently cuts the vein, offsetting it to the southwest.

A quartz vein 1 to 48 inches in width, striking approximately due north and dipping 80° W. to 80° E., cuts the country rock. Locally the vein splits, reverses direction of dip, and flattens to 30°. It consists principally of gouge and clear to milky white quartz, with minor amounts of calcite. In some instances, the vein material is brecciated and recemented by later quartz. Stibnite occurs in the quartz as small pods, streaks, blebs, and single crystals. Elsewhere, stibnite is found in gouge with only minor

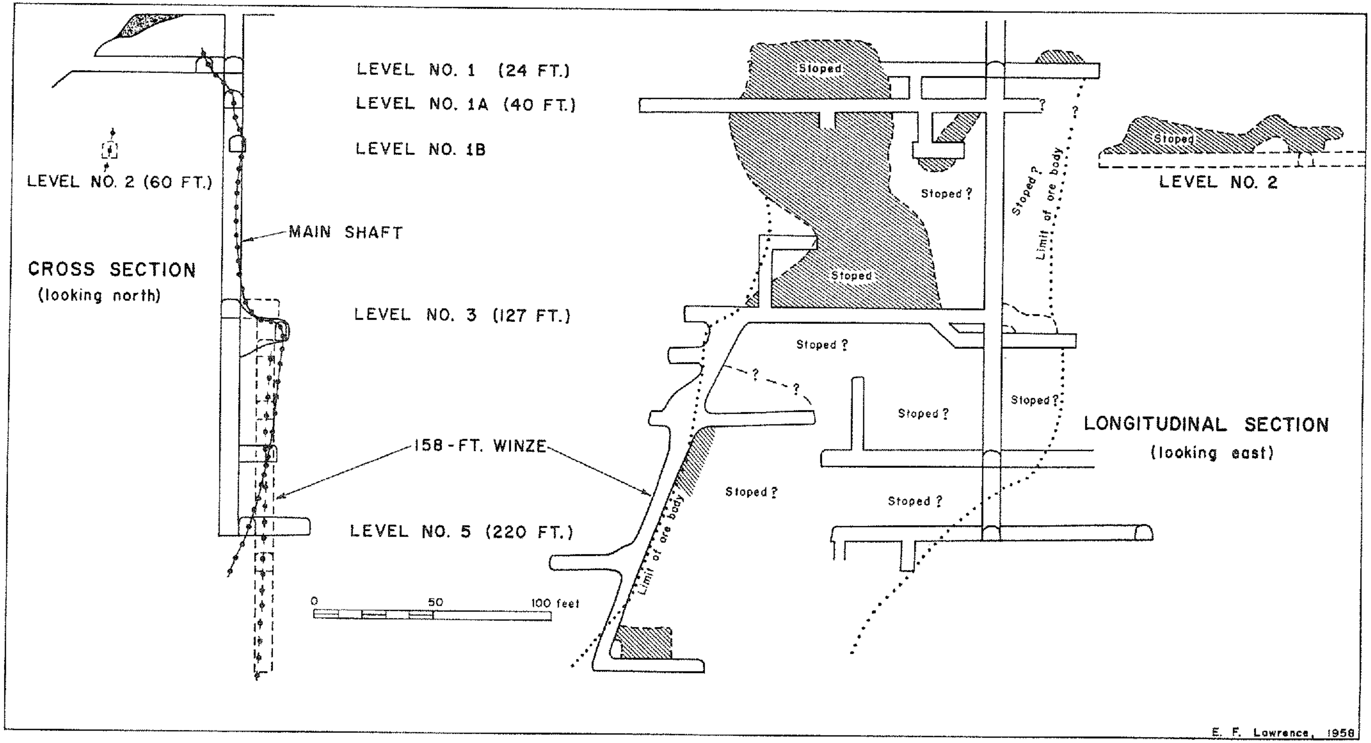

FIGURE 69. Cross section, Sutherland mine, Pershing County, Nevada.

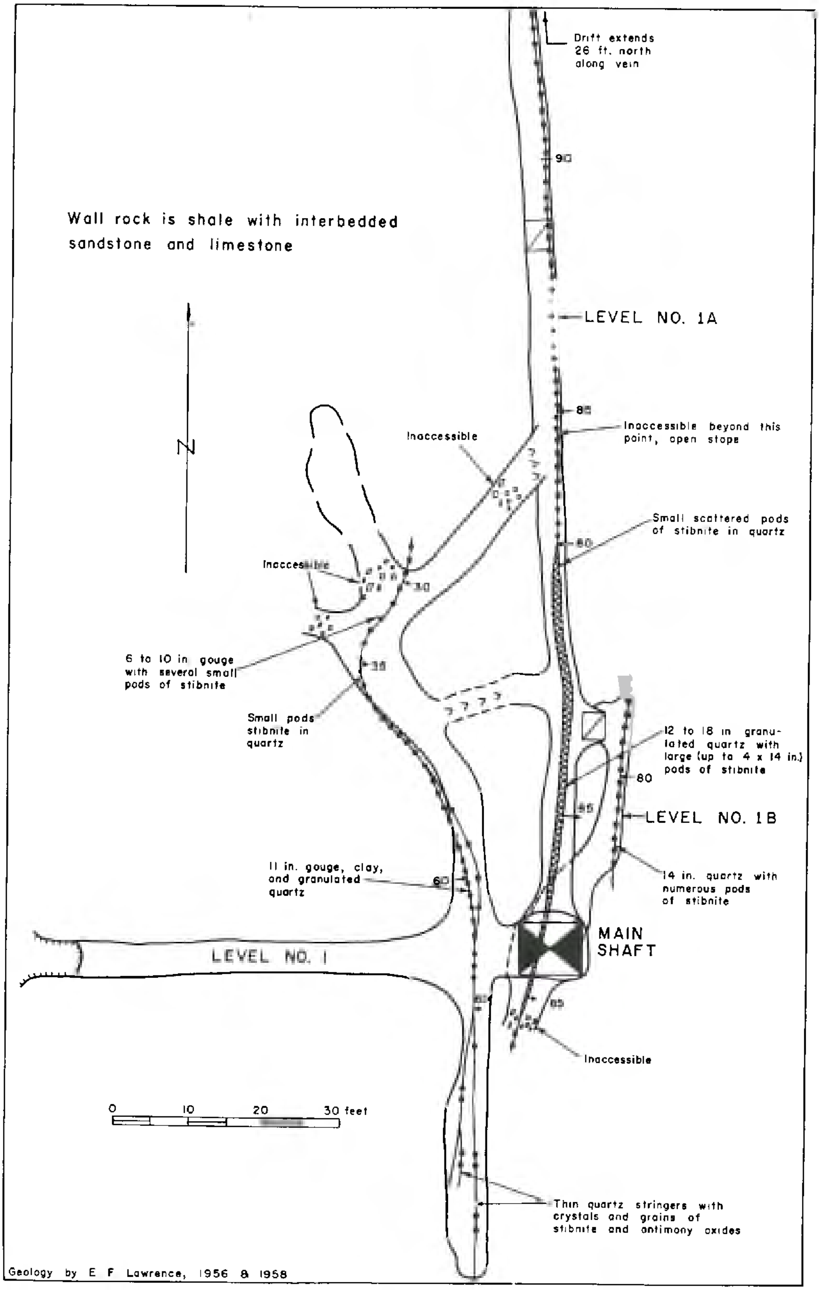

FIGURE 70. Geologic map, Nos. 1, 1A, and 1B levels, Sutherland mine, Pershing County, Nevada.

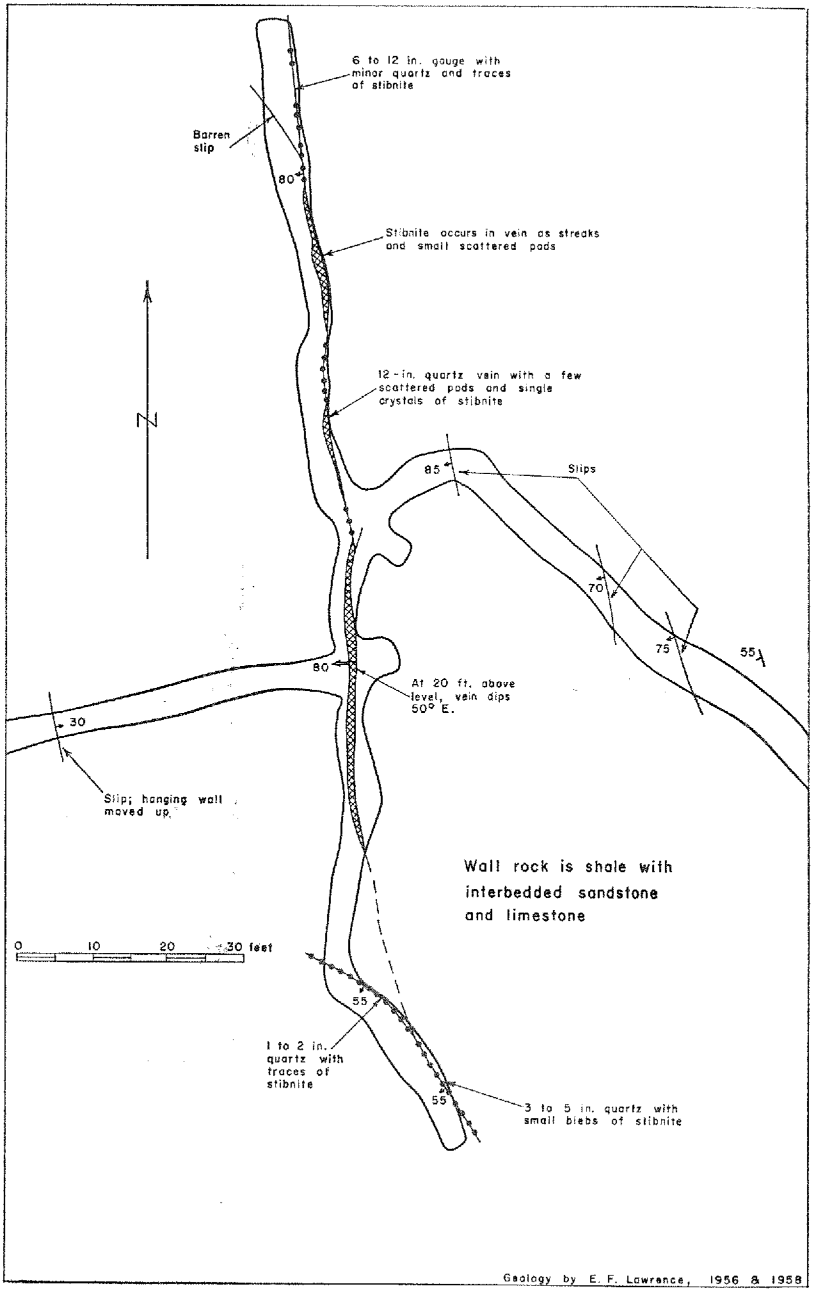

FIGURE 71. Geologic map, No. 2 level, Sutherland mine, Pershing County, Nevada.

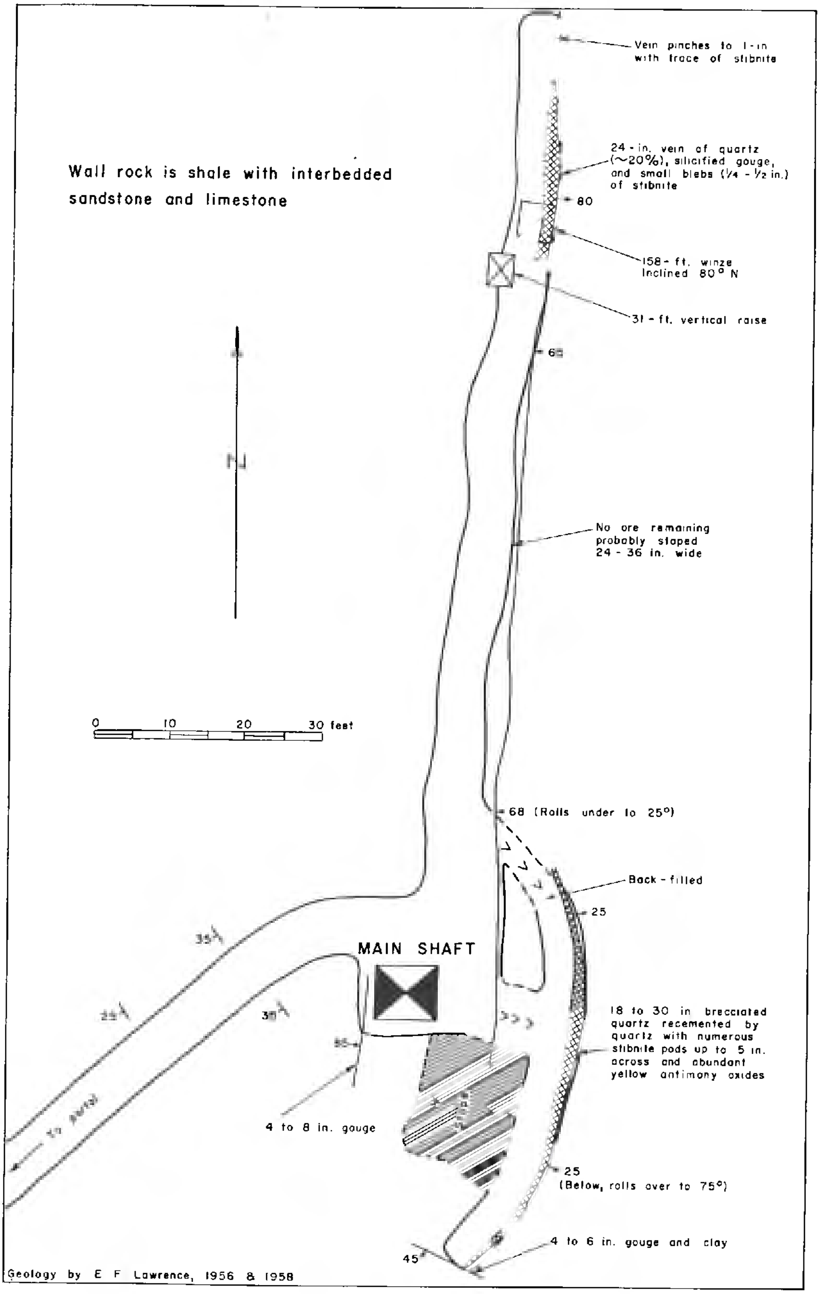

FIGURE 72. Geologic map, No. 3 level, Sutherland mine, Pershing County, Nevada.

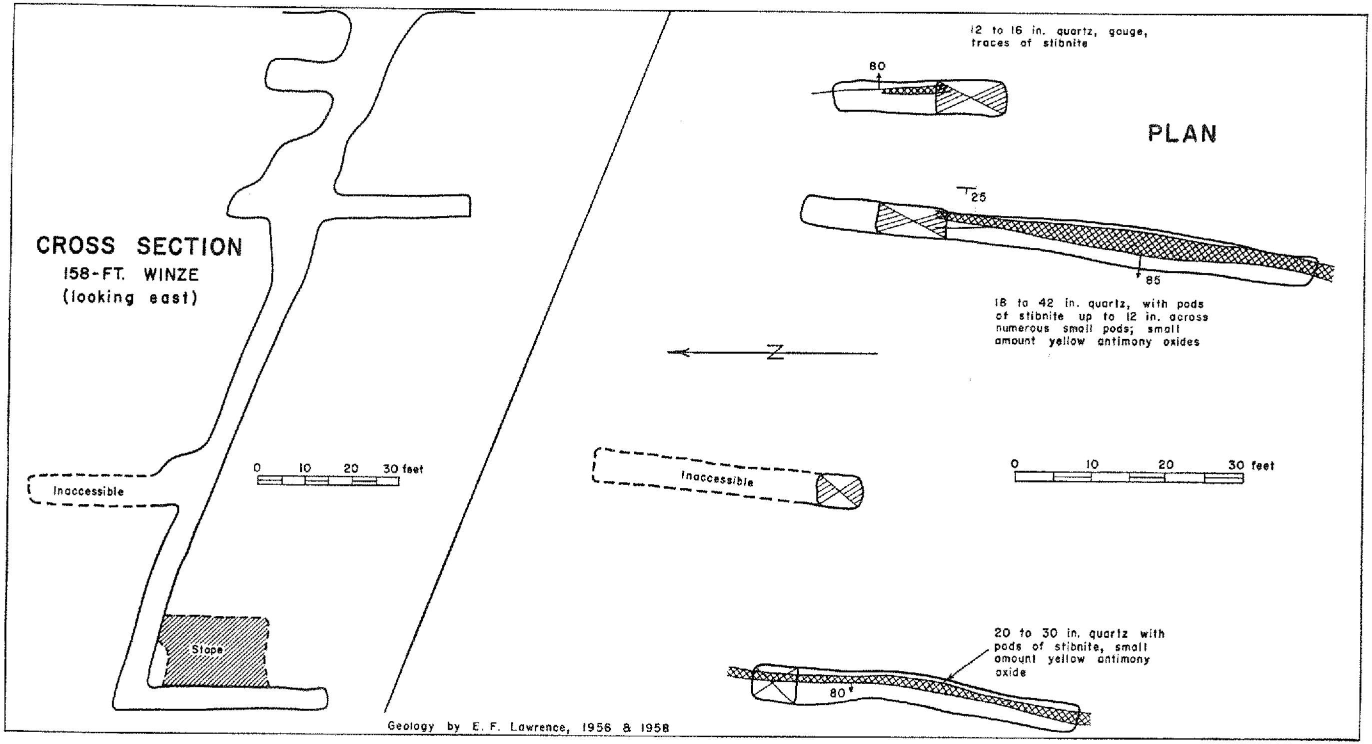

FIGURE 73. Plans and vertical section of the 158-foot winze workings, Sutherland mine, Pershing County, Nevada.

quartz. Pyrite is scattered sporadically throughout the vein, apparently being more abundant on the lower levels of the mine. The wall rock is kaolinized up to 18 inches from the vein; locally it is slightly silicified.

Stibnite has been slightly oxidized to the full depth of the mine, but the intensity diminishes with depth. Both yellow and white oxides are present, but the yellow oxide is more abundant. A small amount of red oxysulfide, kermesite (?), also occurs.

An ore shoot occurs on level 1 (fig. 70) where the vein reverses direction of dip and flattens to 60° E. near the shaft. North of the shaft the vein flattens to 30° E., and then steepens and reverses direction to 80° W. on level 1A. This area has been stoped, but now is largely caved. Apparently the ore-shoot was up to 36 inches wide.

At the south end of the drift on level 2, the vein feathers out in shale. On this level (fig. 71), a crosscut driven 180 feet east from the vein found only minor faults with no antimony ore.

On level 3 (fig. 72), near the main shaft, the vein flattens to 25° E. for 23 feet, then steepens to 75° E. forming an ore shoot in the highly brecciated sandy wall rock. The vein is up to 48 inches wide, half of which is gouge. The ore is composed of a continuous zone of small (1- to 2-inch) pods of stibnite in quartz. One area 24 to 30 inches wide and 10 feet long was seen to average approximately 20 percent antimony.

In workings driven from the 158-foot winze (fig. 73), the vein is 2 to 36 inches thick and varies in dip from 80° E. on the 17-foot level to 80° W. on the 141-foot level (268 feet vertically below the collar of the main shaft). On the 141-foot level, the ore shoot is 60 feet long, and consists of quartz, some calcite, and pods of stibnite up to 12 inches across. In the bottom of the winze, an 18-inch-wide by 20-foot-long ore shoot containing approximately 20 percent antimony is exposed.

A hole was diamond drilled in 1948 at a 45° angle west from a station north of the main shaft. The hole penetrated brown to gray shale and a few quartz stringers containing a little pyrite, but no ore was encountered. However, a short cross cut north from the winze disclosed that the hole on the 100-foot level had passed through a restricted, barren part of the vein. This penetration was only 15 feet north of the ore shoot.

North of the main workings the narrow (1- to 2-inch-wide) vein has been prospected by a 45-foot shaft that according to White (unpublished data, U. S. Geol. Survey) reveals only traces of antimony. This shaft is now filled with debris to the 24-foot level.

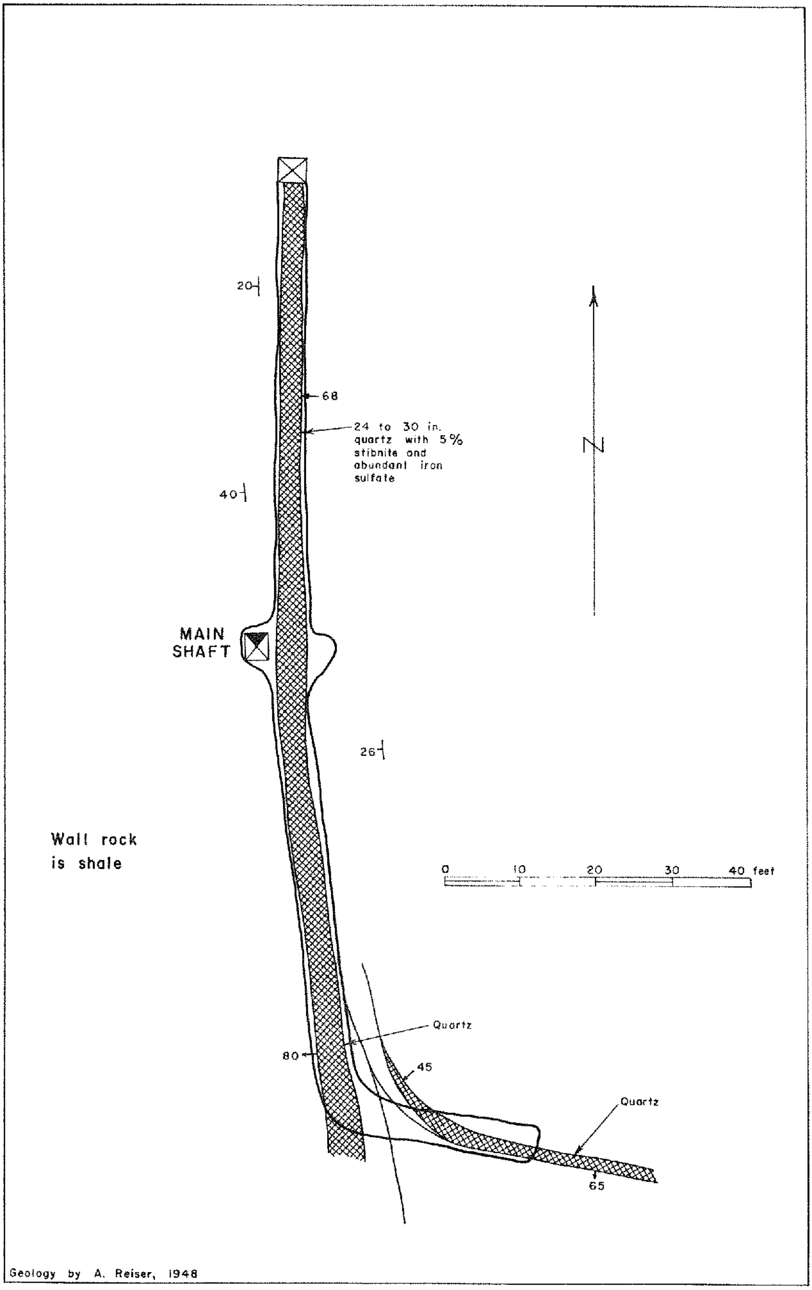

FIGURE 74. Geologic map, No. 5 level, Sutherland mine, Pershing County, Nevada.

A short adit about 350 feet south of the main shaft exposes a quartz vein 2 to 4 inches wide striking N. 15° E. and dipping 45° W., and containing a small amount of stibnite and antimony oxides.

On level 1A (fig. 70), the vein, though variable in thickness, evidently is quite wide as the stopes are nearly continuous.

The antimony mineralization probably is related to the intrusion of the volcanic plugs to the west of the mine, especially to the silicification of the plugs. Ore shoots are larger and richer where the vein enters harder sandstone and are narrow, lean, and discontinuous in the more shaly beds.

The antimony content of six ore samples taken from the Sutherland mine is shown in the following table:

No.	Location	Description	Sb %
1	Level 2, at east crosscut	Stope fill	3.6
2	Level 2, 10 feet north of crosscut	Stope fill	4.2
3	Level 2, 20 feet north of crosscut	Stope fill	8.2
4	Level 2, 30 feet north of crosscut	Stope fill	3.8
5	Level 2, 40 feet north of crosscut	Stope fill	0.8
6	Stope, level 2	12-inch vein	12.6

St. Anthony mine

The St. Anthony mine is 3 miles west of Toy on the east flank of the Trinity Range in sec. 34, T. 25 N., R. 29 E. (see USGS Carson Sink 15′ topographic quadrangle). White (unpublished data, U. S. Geol. Survey) mentioned that assays of tungsten concentrates from the St. Anthony mine showed antimony. In 1944, J. Heizer reported (private report) that 20 tons of antimony ore then on the dump assayed 40.9 percent antimony, 0.03 percent selenium, 0.02 percent arsenic, and a trace of copper. This was mined from an 8-inch streak of stibnite in a 20-foot shaft. A cursory examination failed to disclose any antimony minerals.

Willow Creek prospect

Schrader (unpublished data, U. S. Geol. Survey) reported an occurrence of antimony, belonging to Peter Organ, on Willow Creek in the East Range, (T. 31 N., R. 36 E.), (see USGS Sonoma Range 1° topographic quadrangle map). An examination of this area failed to disclose any antimony minerals.

WASHOE COUNTY

Several antimony occurrences are known in the Cottonwood Canyon mining district in the Fox Mountains, 15 miles southwest of Gerlach. The area consists mainly of granite flanked by Mesozoic sediments and basalt flows (Overton, 1947, p. 60, and Hill, 1915, p. 182).

Pah Rah Range

Donatelli mine

Other names	Georgianne.
Location	Secs. 29 and 30, T. 22 N., R. 22 E.
Production	0.5 ton (metal).
Base map	USGS Spanish Springs Valley 15′ topographic quadrangle.

The Donatelli mine is in the Pah Rah Range on the north side of Right Hand Canyon, approximately 12 miles southwest of Nixon.

The mine was discovered in 1908 by L. C. Beckwith. In 1939 and 1940 respectively, George D. Hopkins and John E. Gaut located the Georgianne and Maryjane claims. In 1940, one ton of ore averaging 29.4 percent antimony was mined. The mine is developed by several shallow shafts, short adits, and trenches (fig. 75).

Biotite-hornblende granite crops out at the mine. Nearby, where the granite is in contact with calc-silicate rocks, considerable prospecting has been done for tungsten. The granite is locally argillized; elsewhere it is partially sericitized. A narrow fine-grained granite dike, striking N. 60° E., cuts the coarser granite. A shear zone 12 to 96 inches in width dips 65° SE. and follows the dike. A vein up to 36 inches in width occurs in the zone. The vein consists principally of quartz with minor calcite. Single crystals, disseminated grains, and small pods of stibnite up to 4 inches across occur in the quartz. Pyrite, malachite, and azurite are associated with the stibnite. The stibnite has been partially altered to white and yellow oxides. These oxides are fibrous to pitchy, and less commonly earthy and powdery. A small amount of red oxysulfide (kermesite?) forms halos around grains of stibnite. A sample of vein material assayed 38.73 percent antimony, 0.56 ounces per ton of silver, a trace of gold, and no selenium.

Sleepy Joe mine

The Sleepy Joe (Kyle, Mint, Eveland, Anti) mine is 280 feet northeast of the inclined shaft at the Donatelli mine. The property is developed by a 25-foot adit, 15-foot inclined shaft, a caved shaft, and an open cut (fig. 76).

Numerous, narrow aplite, fine-grained granite, and pegmatite dikes cut granite. A quartz vein, striking N. 25° E. and dipping 35° SE., is paralleled by a second quartz vein which to the north changes strike and intersects the main vein. A fine-grained

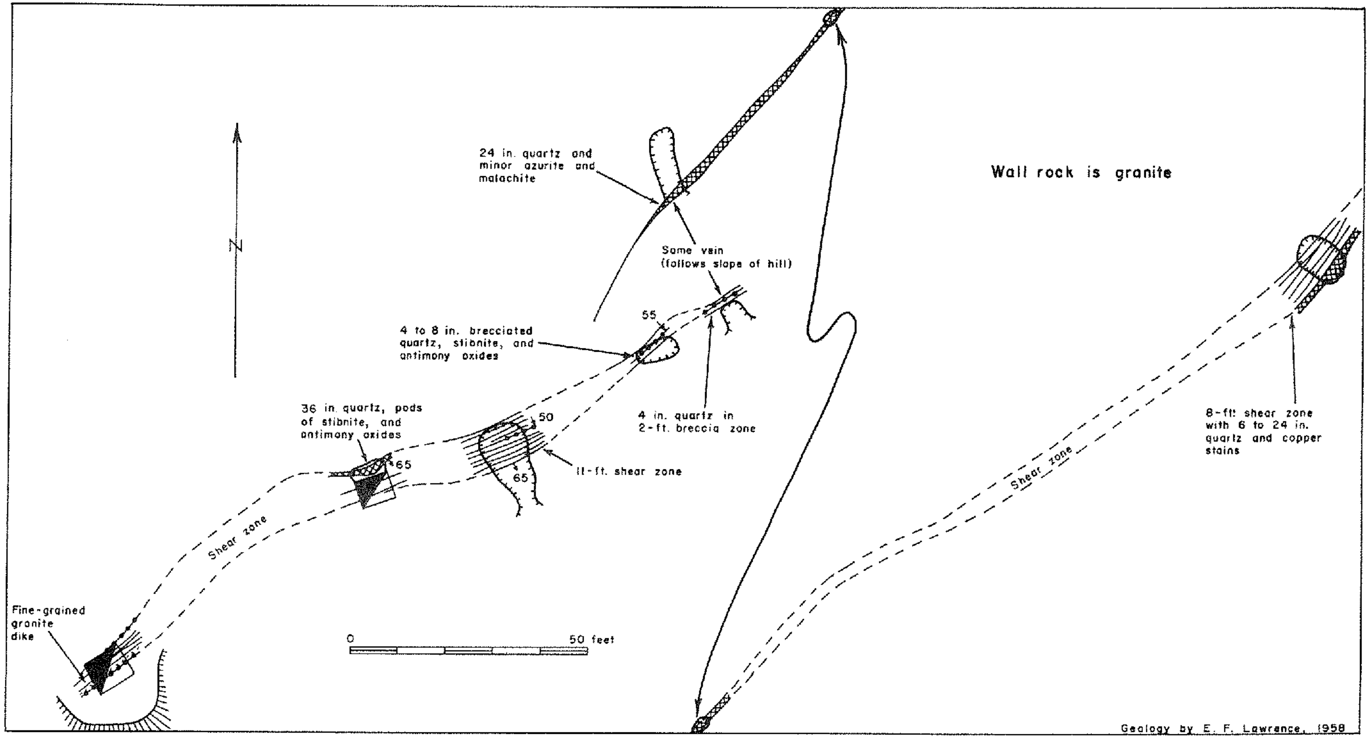

FIGURE 75. Geologic map of the Donatelli mine, Washoe County, Nevada.

granite dike 14 to 18 inches in width is in the footwall of the main vein. This dike is similar to the biotite-hornblende granite dike at the Donatelli mine. Antimony ore occurs at the intersection of the two veins. The veins are mainly quartz, brecciated and recemented by later quartz. The ore shoot comprises small pods and single crystals of stibnite found in the quartz together with some pyrite and chalcopyrite. Stains of antimony oxide and copper carbonates are common.

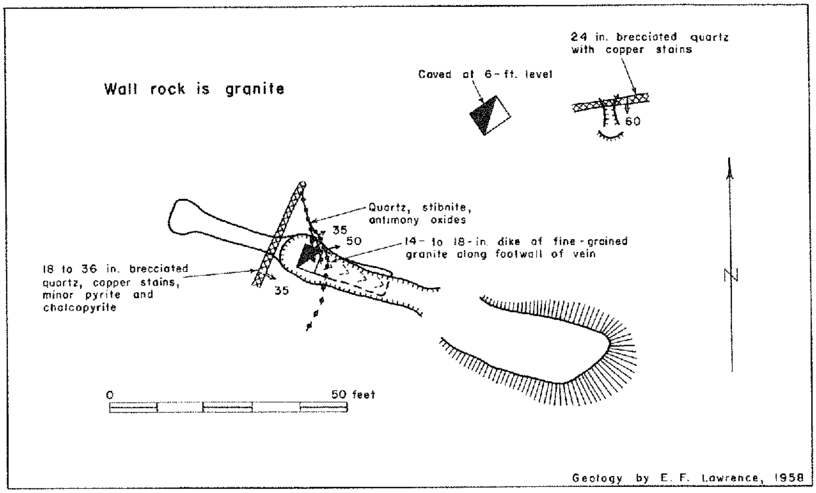

FIGURE 76. Geologic map of the Sleepy Joe mine, Washoe County, Nevada.

Other Occurrences in Washoe County

Angelia prospect

Other names	Molib (?).
Location	Sec. 35, T. 24 N., R. 24 E.
Ownership	Zeb Turner, of Wadsworth.
Production	None.
Base map	USGS Fireball Ridge 15′ topographic quadrangle.

The Angelia prospect is situated on the south end of the Truckee Range, 10 miles northeast of Nixon. The deposit at one time was worked for gold and silver. This apparently is the same as the Molib claim owned by T. W. Hebbard from which samples containing over 10 percent antimony were taken (White, unpublished data, U. S. Geol. Survey). There are several shafts and open pits, but antimony was found in only one pit.

A vertical quartz vein, striking N. 20° E., follows a contact between granodiorite and phyllite. Stibnite occurs in the vein as crystals in vugs, small pods, and masses up to 6 inches across. It is found also as single crystals in silicified phyllite. The stibnite has been partially oxidized to yellow and white antimony oxides. The yellow oxide is pitchy to earthy; powdery yellow oxide occurs along fractures and floods the wall rock up to several inches from the vein. The white oxide is earthy to fibrous.

Choates mine

Other names	Freeman mine, Stibnite prospect, Jellison mine.
Location	Secs. 7 and 18, T. 21 N., R. 21 E.
Ownership	North American Aviation, Inc. (1960).
Production	32 tons antimony (metal).
Base map	USGS Spanish Springs Valley 15′ topographic quadrangle.

The Choates mine is north of Sugarloaf Peak, 12 miles north of Sparks and 1 mile east of State Highway 33. Nothing is known of the early history of this mine. Twenty-seven tons of ore containing 52 percent antimony were produced in 1940 by the operator, E. Walters. Eleven tons of ore averaging 56 percent antimony were produced in 1941, and 19 tons of ore averaging 62.5 percent antimony in 1942. The mines is developed by two adits, one 50 and the other 111 feet long (fig. 77). Some stoping has been done between the two adits.

At the mine, granite is cut by a number of crisscrossing aplite dikes, but a short distance away the granite is covered by rhyolite (?) flows. One mile to the north, this intrusive is in fault contact with schist.

Mineralization is found along several veins in the mine. The easternmost adit contains a vein which dips to the east at a low angle (fig. 77), and is thought to be the arched-over continuation of the westward-dipping vein in the western adit. Another vein segment which strikes N. 45° E. and dips 20° to 50° SE. is believed to be a split from the main vein. Vein material includes quartz, stibnite, and minor pyrite. Pods up to 4 inches long, streaks, and individual crystals of bladed stibnite are scattered through the quartz. A sample of the main vein assayed 22.73 percent antimony, 0.06 ounce per ton of silver, a trace of gold, and no selenium.

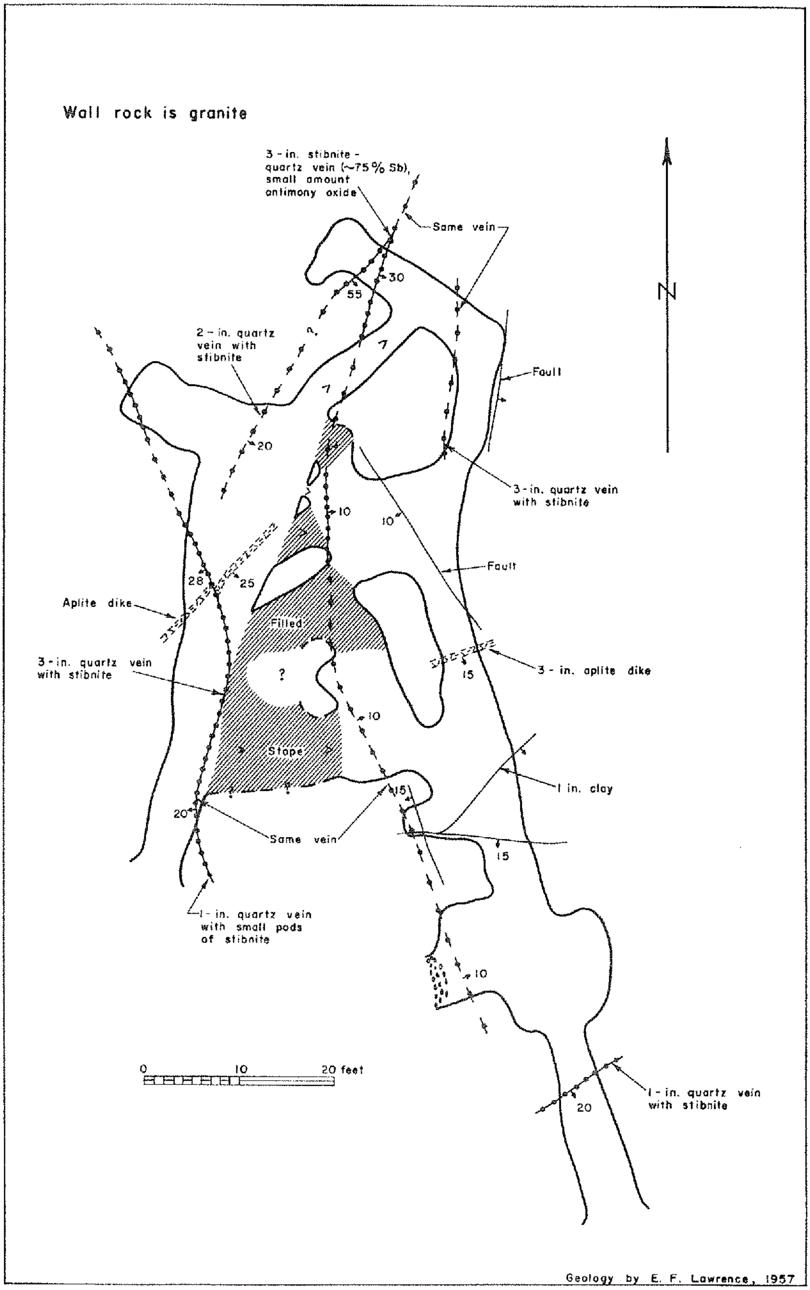

FIGURE 77. Geologic map of the Choates mine, Washoe County, Nevada.

Stibnite has been partially altered to yellow, white, and brown antimony oxides. Most of the oxides occur as pseudomorphs after the sulfide. Some are earthy to powdery. A small amount of a red oxysulfide (kermesite?) encloses grains of stibnite. Pyrite commonly is replaced by limonite. Orthoclase and albite crystals in the granite have been sericitized for several inches outward from the veins.

Mines in Cottonwood Canyon

Cottonwood Canyon is located 7 miles north of Pah-rum Peak, in the Cottonwood Canyon mining district, on the east flank of the Fox Mountains (see U. S. 1:250,000 scale topographic map, Lovelock sheet). No antimony has been produced in this district.

Hill (1915, p. 183) stated:

> "The valuable metals (in the Cottonwood Canyon mines) are chiefly silver and lead, carried in galena and some antimonial mineral, possibly gray copper. Some ore from the Cottonwood Canyon mines seen at Gerlach consists largely of galena and quartz together with small crystals that appeared to be stibnite."

Kohl prospect

White (unpublished data, U. S. Geol. Survey) mentioned that in 1941 Le Roy Kohl shipped 6 tons of ore containing 33 percent antimony from a deposit in Washoe County. A careful check of the records in the Washoe County Recorder's office failed to reveal any mining claims held by Le Roy Kohl. This ore probably came from one of the other antimony deposits described above.

Ross prospect

The Ross prospect (Sano mine?) is on the south end of the Fox Mountains, in secs. 5 and 8, T. 28 N., R. 21 E. (see U. S. 1:250,000 scale topographic map, Lovelock sheet), 1 mile northeast of Sand Pass on the Western Pacific Railroad. No antimony ore has been produced. Only very small amounts of tetrahedrite and stibnite are present. The prospect was not visited.

Steamboat Springs

Steamboat Springs is 10 miles south of Reno along U. S. Highway 395 in secs. 28 and 33, T. 18 N., R. 20 E. (USGS Virginia City 15′ topographic quadrangle). Although antimony does not occur in mineable amounts, this occurrence is of considerable geologic interest.

Granodiorite is overlain by Tertiary and Quaternary volcanic rocks and alluvial sediments in the vicinity of the springs. The hot springs here probably reflect an end phase of Cenozoic volcanic activity.

Becker (1888, p. 343) reported the occurrence of antimony at Steamboat Springs in the form of a red sulfide. His analyses showed too little mercury to account for the red color, so he designated the mineral metastibnite.

Stibnite was first reported at Steamboat Springs by Lindgren (1906, p. 29). At the bottom of a 30-foot shaft near the railroad station, crystals of stibnite up to 1 mm long with associated pyrite have been deposited on stream gravel. Lindgren believed these sulfides were deposited from hot water which passed through the gravel.

Brannock and others (1948, p. 223) stated:

> "Minute acicular crystals of stibnite in individual crystals and rosette-like clusters barely indentifiable with a 20x hand lens make up 0.2 to 4.0 percent of the mud by weight. . . . Stibnite was also found floating as a thin scum on the surface of spring waters, . . . The mud from spring No. 27 contains as much antimony as the mine-run of material removed from most antimony mines in the United States and Mexico."

Clusters of acicular stibnite and a small amount of cinnabar are found in opal, and in small cavities in reworked sinter a few tens of feet from surface. The stibnite crystals were larger than those in the mud at surface. At spring No. 24, stibnite is associated with pyrite, chalcedony, quartz, opal, and cinnabar at depth in the sinter. Arsenopyrite, pyrite, stibnite, and cinnabar were found in sinter on the dump west of the springs.

Gianella (1939, p. 471) reported the ejection of a large quantity of "metastibnite" from a well drilled at the south end of the springs. Other wells further to the north have yielded hot water, steam, and minute crystals of pyrite and stibnite.

White, describing the springs in some detail (1955, p. 113), stated that:

> "Stibnite is prominent in veinlets and cavities to depths of a little more than a hundred feet. Geochemical tests show that notable amounts of antimony are present in the altered rock of the spring terraces, but in general antimony decreases with depth, approaching the normal content for the unaltered granodiorite."

Sunset prospect

The Sunset prospect is about 500 feet southeast of the Choates mine (p. 221). It is developed by several trenches, two inclined shafts, and a small amount of underground workings. The property was owned by Phillip Evans in 1957.

The geologic setting is the same as at the Choates mine. Several quartz veinlets with small blebs and crystals of stibnite cut the granite in an irregular pattern. Much of the stibnite has been completely oxidized to yellow and white oxides. The granite is highly weathered, no fresh rock being visible in the workings.

WHITE PINE COUNTY

Bald Mountain Mining District

The Bald Mountain (Ruby Mountain) mining district, is on North (Big) Bald and South (Little) Bald Mountains in the southern part of the Ruby Range. Lincoln (1923, p. 242) credited the district with $20,000 worth of production, but Couch and Carpenter (1943, p. 146) give only $2,663. Values were gold, silver, copper, and antimony.

Paleozoic limestone and dolomite have been intruded by quartz monzonite in the district. The sedimentary rocks form a north-trending anticline whose east limb dips 20°–30° E. and west limb dips 10°–20° W. Two major thrust faults flank the range. A number of tear and normal faults are associated with the thrust faults.

Crown Point mine

Other names	Munter, Hobson.
Location	Sec. 36, T. 24 N., R. 57 E.
Ownership	George Marich, of Ely (1958).
Production	Small.
Base map	USGS Cold Creek Ranch 15′ topographic quadrangle.

The Crown Point mine is 4½ miles southeast of North (Big) Bald Mountain, and about 1,000 feet south of the saddle between Bourne Canyon and Summit Springs.

The mine was first worked for silver (Hill, 1916, p. 160). It is developed by a single adit more than 35 feet in length, only the first 20 feet of which are accessible.

The adit was driven in Devonian Guillmette Limestone near its contact with Devonian Simonson Dolomite (Rigby, 1960, p.

179). About a mile to the east quartz-monzonite has intruded these sedimentary rocks. The light-gray, finely crystalline limestone generally strikes N. 25° E. and dips to the east. A vertical tear fault, striking N. 60° W., forms a brecciated zone.

A vein 2 to 8 inches in width, striking N. 30° E. and dipping 85° W., contains fragments of silicified limestone which has been recemented by quartz and minor calcite. The vein minerals occur as fissure fillings and replacements in the limestone. Stibnite occurs as bladed rosettes, small pods, and single crystals. Needles of stibnite, commonly covered with small quartz crystals, span the open spaces in quartz-lined vugs. Silver is present in the vein as blue, green, and yellow chlorides and bromides. White antimony oxides have replaced the stibnite. A grab sample from the stockpile on the dump assayed 1.34 percent antimony, and 0.04 ounce of gold and 4.46 ounces of silver per ton and no selenium.

Dees mine

Other names	Bisoni prospect, Hollan, Raftice, Munter.
Location	Sec. 8 (?), T. 24 N., R. 57 E.
Ownership	Maynard and Lester Bisoni (1957).
Production	Small.
Base map	USGS Cold Creek Ranch 15′ topographic quadrangle.

The Dees mine is at the head of Newark Valley on a northwest spur of North (Big) Bald Mountain, 400 feet below its summit. According to W. V. Holden (oral communication, 1958), a total of 20 tons of ore, assaying 53 percent antimony, was produced. The mine is developed by two pits and a 15-foot shaft.

At the mine, light-gray to black, finely crystalline, Goodwin Limestone strikes N. 10° W. and dips 15° E. The limestone at the mine is brecciated in a zone striking N. 10° W., and is silicified over the whole area. A mile to the south the limestone has been intruded by quartz monzonite.

Pods up to 4 inches across, and bladed single crystals of stibnite occur both as replacements in the limestone, and, together with quartz and calcite, in fractures in the brecciated zone. The quartz is commonly vuggy. Needles of stibnite are perched on stubby crystals of quartz lining the vugs. The stibnite has been mostly oxidized. Red oxysulfide (kermesite?) fills cleavages and fractures in the stibnite, and fibrous white antimony oxide commonly encloses stibnite crystals. A thin film of yellow antimony oxide coats the white oxide in places. Yellow oxide also forms cellular boxworks and pseudomorphs after needles of stibnite.

Gold King mine

The Gold King (Munter) mine is on Water Creek on the south slope of North (Big) Bald Mountain in sec. 17, T. 24 N., R. 57 E. (see USGS Cold Creek Ranch 15′ topographic quadrangle). The workings were inaccessible in 1957. F. L. Hess (private report, 1916) reported "stibnite and calcite cementing a brecciated vein a few inches wide." Stibnite occurs as minute inclusions in black quartz which line vugs in the vein. Pyrite and marcasite are associated with stibnite in the Gold King No. 1 inclined shaft (Hill, 1916, p. 159). Stibnite also occurs with quartz, pyrite, and marcasite in another vein in an adit half a mile northwest of Joy. The wall rock is sericitized for a few inches on each side of the vein.

Cherry Creek Mining District

The Cherry Creek mining district is in the Egan Range, 50 miles north of Ely and 4 miles west of the Nevada Northern Railroad. Tungsten was discovered in the district in 1915, and several large mines were worked during World War II and the Korean War. Total production has been over $4,000,000 (Couch and Carpenter, 1943, p. 146).

Cambrian shale, quartzite, and limestone have been intruded here by gray, medium-grained quartz monzonite (Schrader, 1931, p. 26). At the town of Cherry Creek, 3,000 feet of quartzite and shaly quartzite of the Prospect Mountain Formation are overlain by gray to blue-gray undifferentiated Cambrian limestone. There apparently is a boundary fault along the west edge of the Egan Range. Parallel faulting and fracturing in the Lage mine area west of this border fault have formed a brecciated zone in limestone. This brecciated zone has since been completely silicified. The silicified area is 100 to 200 feet wide and over half a mile in length.

Three types of ore deposits are found here: (1) scheelite in a contact zone around the larger intrusive bodies; (2) gold-quartz veins with minor pyrite and galena; and (3) quartz veins containing galena, sphalerite, pyrite, and antimonial silver minerals.

Bennett prospect

Anthony Bennett (White, unpublished data, U. S. Geol. Survey) reportedly has an antimony prospect near Cherry Creek, which may be part of the Nevada Antimony mine.

Lage mine

Other names	Antimony Queen prospect, Frank.
Location	Secs. 10 and 15, T. 23 N., R. 61 E.
Ownership	Nevada Antimony Mine, Inc. (1958).
Production	None.
Base map	U. S. 1:250,000 scale topographic map, Ely sheet.

The Lage mine is on the west flank of the Egan Range, 13.2 road miles southwest of Cherry Creek. The mine was first located by A. H. Lage and others in 1937. Some exploration work was done from 1947 through 1949; a few sacks of ore were stockpiled but no shipments were made. The claims were dropped by Lage in 1956 (Lage, 1957, oral communication). This property was overlapped by the claims of the Nevada Antimony mine in 1957 and 1958.

The Lage mine is developed by three open cuts in the silicified limestone frontal fault on the west edge of the Egan Range. The limestone here was brecciated and later silicified and recemented by quartz and minor calcite. Locally, the fracture filling is vuggy, the vugs being lined with stubby quartz crystals and some calcite.

Stibnite occurs as small pods, veinlets, blebs, and single crystals and needles scattered sporadically throughout the silicified zone. In places the stibnite appears to be concentrated along fractures. One fracture zone, striking N. 65° E. and dipping 70° S., is 8 inches wide and contains small pods and single crystals of stibnite. A fault, striking N. 15° W. and dipping 70° E., cuts this fracture zone and contains gouge and a few blebs of stibnite. The stibnite apparently was deposited simultaneously with the quartz. In some vugs quartz crystals are perched on needles of stibnite.

The stibnite commonly is partially oxidized. Red oxysulfide occurs along fractures and cleavages in the sulfide. Yellow oxide is common both as pseudomorphs after stibnite and as powdery to vitreous coatings and cellular boxworks. Fibrous white antimony oxide replaces bladed stibnite and forms pseudomorphs. Several samples taken randomly over the property average less than 1 percent antimony; however, selected pods would assay up to 30 percent antimony.

Nevada Antimony mine

Other names	Antimony No. 2 lode, Fernandez prospect.
Location	Secs. 10, 11, 14, 15, T. 23 N., R. 61 E.
Ownership	Benito Fernandez and Al Kinslow (1958).
Production	None.
Base map	U. S. 1:250,000 scale topographic map, Ely sheet.

The Nevada Antimony mine is on the west flank of the Egan Range, a short distance east of the Lage mine. Three open cuts explore a silicified zone which strikes N. 40° W. and dips 65° N. In this zone the limestone has been brecciated, silicified, and recemented by quartz and minor calcite.

Stibnite occurs as pods, blebs, veinlets, single bladed crystals, and radiating needles in veinlets with quartz and also replaces the limestone. Some pods are up to 22 inches across and are locally found in concentrations large enough to form ore shoots. Quartz-lined vugs commonly contain single needles of stibnite up to half an inch in length. A grab sample from the stockpile downhill from the pit assayed 20.44 percent stibnite, 0.26 ounce of silver per ton, and no gold. A second silicified zone, striking east and dipping 65° N., occurs 60 feet south of the main open cut. It contains stibnite in a 6-inch quartz vein and as replacements in the limestone. This zone can be traced eastward for more than 200 feet.

The stibnite commonly is at least partially oxidized. Red oxysulfide has formed along fractures and cleavage planes. White, vitreous to fibrous antimony oxide is common as pseudomorphs after stibnite. Yellow, earthy to powdery antimony oxide replaces stibnite and forms coatings on fractures.

Taylor Mining District

The Taylor mining district is on the west side of the Schell Creek Range, 17 miles southeast of Ely in T. 14 N., R. 65 E. (see USGS Conners Pass 15′ topographic quadrangle). Over a million dollars worth of silver, gold, copper, lead, and antimony have been produced (Couch and Carpenter, 1943, p. 148).

Devonian carbonate rocks are overlain by Mississippian sandstone and shale in turn overlain by Pennsylvanian Ely limestone. Two fine-grained porphyry dikes, now highly altered, have intruded the sedimentary rocks. The antimony mines described below are in the Ely Limestone (?), approximately three-fourths of a mile north of Taylor. There a silicified zone in the limestone, striking N. 20° E. to N. 30° W., extends for more than 2 miles. The Merrimac mine is at the north end of this zone; the Enterprise mine is at the south end.

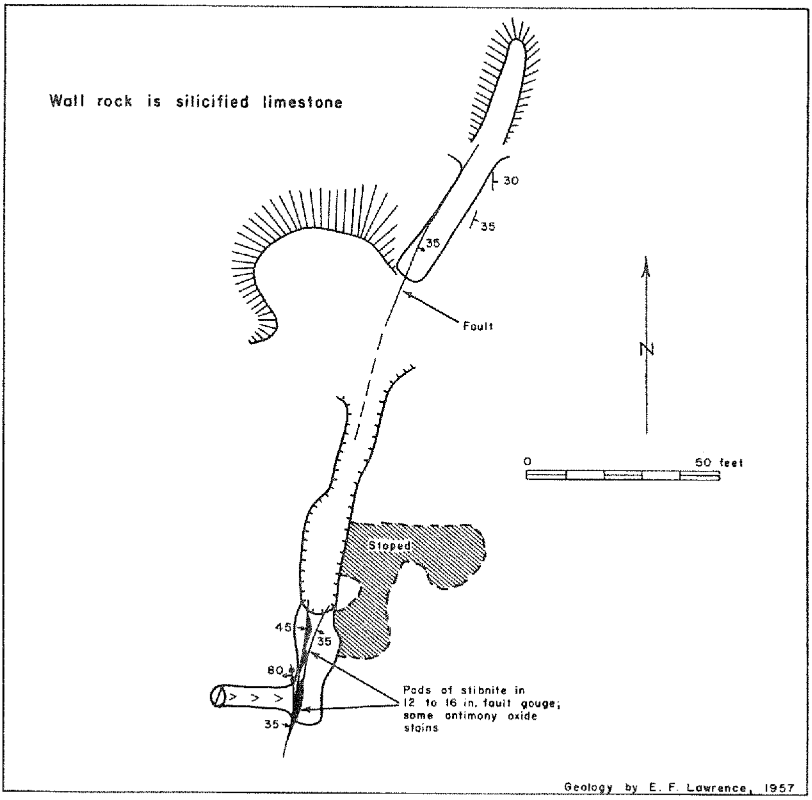

FIGURE 78. Geologic map of the Enterprise claim, White Pine County, Nevada.

Enterprise mine

Other names	Arnold, Antimony Chief, Apex, McKenzie, Pappy, Hulse, Sheldon, Marriott.
Location	Secs. 16 and 21, T. 14 N., R. 65 E.
Ownership	Claude Gardner (1958).
Production	12 tons antimony (metal).
Base map	USGS Conners Pass 15′ topographic quadrangle.

The Enterprise mine is located approximately 1 mile south of Taylor. It includes a number of adjacent claims, by whose names it is also known. First located in 1914, the property was later relocated and worked from 1939 through 1941 by R. P. Arnold as the Enterprise Mining Co. Arnold built an oxide plant in 1939; shipped 13 tons of ore averaging 56 percent antimony in 1939, 6 tons of ore averaging 39 percent antimony in 1940, and 1 ton of oxide containing 76 percent antimony in 1941. In 1959, the Nokai Dome Oil Co. rebuilt the oxide plant on the old Enterprise mill site and operated it on ore from the Merrimac mine (see below).

The Enterprise (Antimony Chief) claim is developed by an open cut and an adit and winze from the open cut. Some stoping has been done from the winze. A small prospect pit 350 feet to the south shows stibnite in limestone. Silicified limestone, striking N. 85° E. and dipping 30°–35° E., crops out at the workings. A vein, striking N. 10° E. and dipping 35° E., cuts the limestone (fig. 78). This is 12 to 16 inches wide, and is composed of gouge and pods of quartz and stibnite. The hanging wall is thin bedded and shaly, the footwall is brecciated and highly silicified, and has a cherty appearance. Stibnite occurs as pods up to 12 inches across, as needles up to 1.5 inches long replacing limestone, and as veinlets up to 6 inches wide. It commonly has been replaced by white fibrous antimony oxide and by yellow powdery antimony oxide.

The Pappy claim, immediately to the north of the Enterprise claim, is developed by a shallow shaft and a prospect pit. A few blades of stibnite as well as blue and green copper carbonates are present in the shaft. Some stibnite and white antimony oxide occur along a cliff face in the nearby wash.

The McKenzie (Apex 3 and 4) claims are north of the Pappy claim in the southeast quarter of sec. 16. These claims are developed by a 30-foot inclined shaft, a 13-foot vertical shaft, and an open cut (fig. 79). The country rock is brecciated and silicified gray crinoidal limestone striking N. 30° E. and dipping 30° E. Stibnite occurs as veinlets, small pods, rosettes, and single crystals; one lense 64 inches across was seen to contain numerous blades of stibnite as replacements of the limestone.

Minor red oxysulfide is present along cleavages and fractures in the stibnite. Antimony, gold, and silver values in five ore samples from the Enterprise mine are shown in the following table:

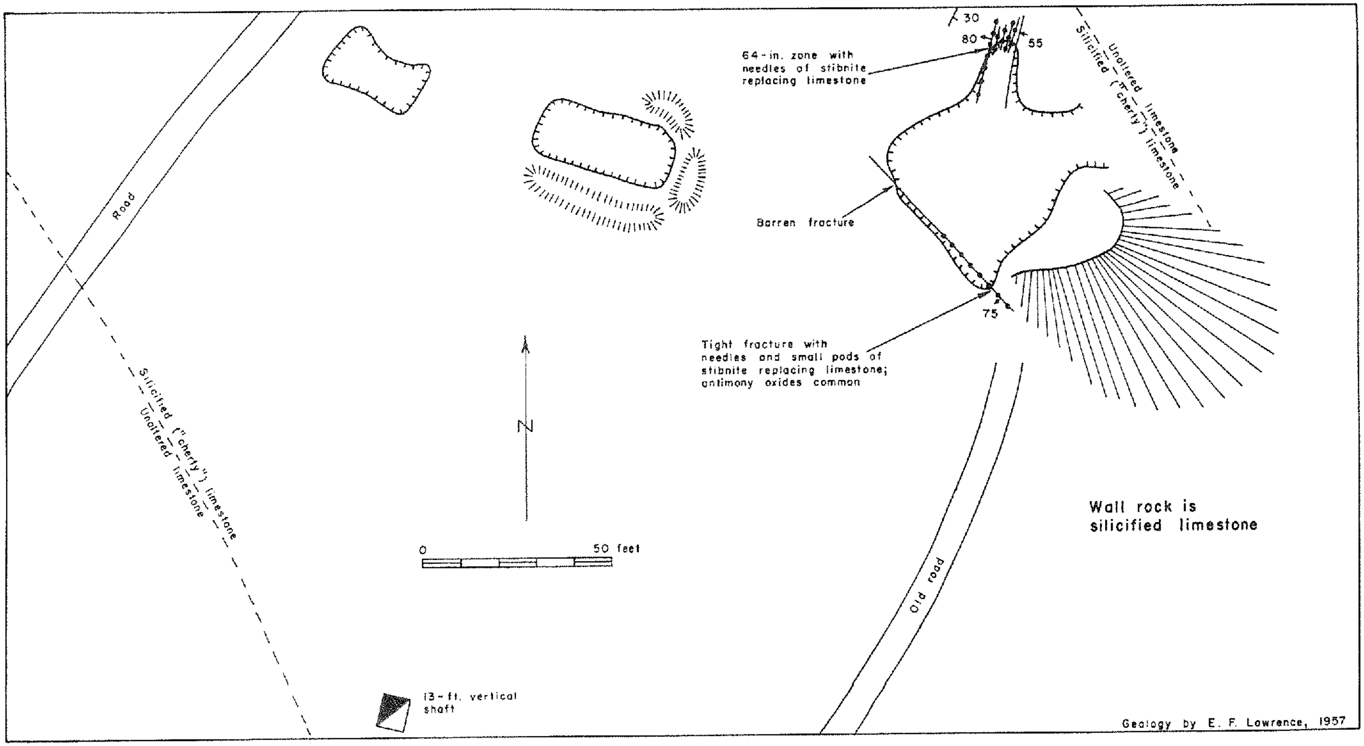

FIGURE 79. Geologic map of workings on the McKenzie claims, Enterprise mine, White Pine County, Nevada.

No.	Description	Sb %	Au oz.	Ag oz.
112	Stibnite-bearing pods	11.7	0.01	1.24
113	Stibnite-bearing pods	4.90	0.14	6.0
114	Stibnite-bearing pods	20.70	.....	.....
105	McKenzie claims, 48-inch face (open cut)	3.91	None	0.40
106	McKenzie claims, 64-inch face, silicified limestone with needles of stibnite	4.39	0.01	0.76

Merrimac mine

Other names............Amelia, Vermilion, Nokai.
Location............Secs. 4, 9, 10, 15, and 16; T. 14 N., R. 65 E.
Ownership............Claude Gardner, of Taylor (1958).
Production............13 tons antimony (metal).
Base map............USGS Conners Pass 15′ topographic quadrangle.

The Merrimac mine is 17 miles southeast of Ely and about a mile north of the Enterprise mine. The Nokai Dome Oil Co. leased the property in 1959 and 1960 and mined 90 tons of ore averaging 14 percent antimony. The company erected an ore-roasting furnace at the old Antimony Chief property. Two and one-half tons of white oxide had been produced by July, 1960 (Gene Gillson, oral communication, 1960). Reportedly, the mine and furnace were closed down in September, 1960. The property consists of six claims developed by two shafts, one 10 and the other 30 feet deep, and by six open cuts.

Gray thin-bedded to massive Ely Limestone of Pennsylvanian Age, striking N. 15° W. to N. 15° E. and dipping 20°–30° N., crops out at the mine. A silicified and brecciated fault(?) zone 30 to 45 feet wide, striking N. 30° W., cuts the limestone (fig. 80). Stibnite occurs as blebs, small pods, veinlets, bladed individual crystals, and rosettes of needles sporadically distributed throughout the zone. The pods are up to 6 inches across; the needles are as much as 2 inches in length. Locally, stibnite is abundant enough to form ore shoots. Stibnite commonly has been partially oxidized to antimony oxides. The white oxide is fibrous, and replaces bladed stibnite, while the yellow oxide stains the white oxide, fills fractures as powdery coatings and earthy masses, and is pseudomorphic after stibnite. Antimony and other values found in four samples of this ore are shown in the following table:

No.	Description	Sb %	Au oz.	Ag oz.	Pb %	Zn %	Cu %	As %
108	Grab sample, 12-ton stockpile	3.90	Tr.	0.16	Tr.	Tr.	0.09	None
109	Vein material	14.5	Tr.	0.76	Tr.	0.19	0.05	Tr.
110	Vein material	9.83	Tr.	0.40	Tr.	0.21	0.08	Tr.
111	Grab sample, 8-ton stockpile	29.03	Tr.	7.08	Tr.	1.49	0.05	.....

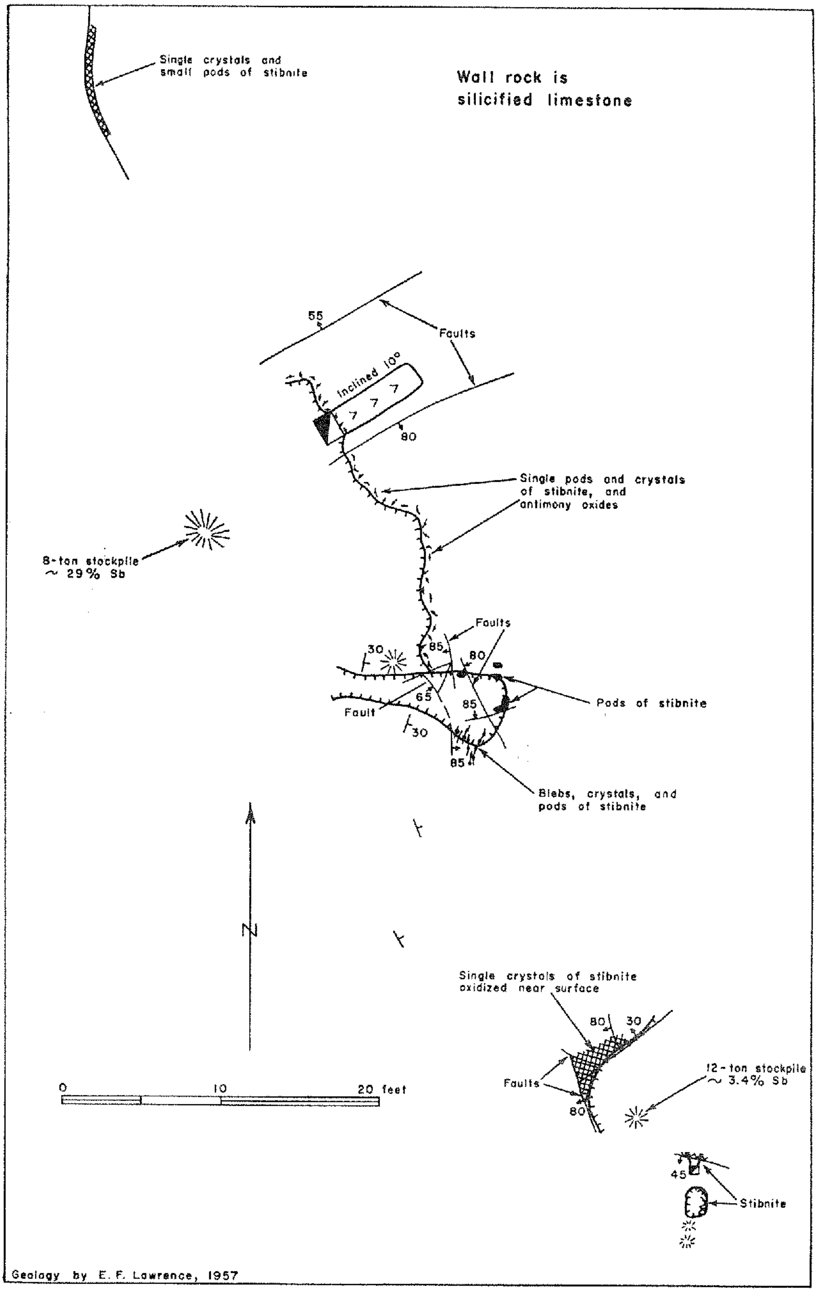

FIGURE 80. Geologic map of the Merrimac mine, White Pine County, Nevada.

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The Nevada Bureau of Mines and Geology (NBMG), and the Nevada Mining Analytical Laboratory (NMAL), are charged by state law with the duty of investigating and reporting on the geology and mineral resources of the State. Operated as a unit, NBMG/NMAL are research and public service divisions of the University of Nevada Reno. NBMG/NMAL have no regulatory functions.

NBMG performs research, compiles information, and makes the information available through: 1) published maps and reports; 2) unpublished data files and collections; and 3) talks, correspondence, and personal contacts. NMAL provides assaying and mineral identification services. NBMG, through its affiliation with the National Cartographic Information Center, also provides information and assistance on base maps and airphotos.

NBMG research includes all phases of Nevada's geology and mineral resources: 1) basic geologic mapping and laboratory studies; 2) geophysical and geochemical surveys; 3) engineering geology; 4) geologic considerations in urban and rural planning; 5) the preparation of educational guides and booklets; 6) statewide investigations of mineral commodities; 7) the geology of ore deposits; and 8) the exploration, development, mining, processing, utilization, and conservation of metal ores, industrial minerals, fossil and nuclear fuels, geothermal power, and water.

NBMG/NMAL offices are located in the Mines Wing of the Scrugham Engineering-Mines building on the University of Nevada Reno campus; office hours are 8:00–4:30, Monday through Friday.

For information concerning the geology and mineral resources of Nevada, contact: Director/State Geologist, Nevada Bureau of Mines and Geology, University of Nevada Reno, Reno, NV 89557-0088. A publication list will be sent upon request.