OME-6500

Geologic Report

SILVER HILL AREA

Aurora (Esmeralda) Mining District, Nevada

See revised program dated Oct. 19, 1965.

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By

Anthony L. Payne

August, 1965

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INTRODUCTION

The Aurora mining district is one of 30 Nevada precious metal* districts which were soil sampled during 1964 in a program of geochemical reconnaissance by Great Basin Exploration Company of Reno, Nevada. This field and laboratory investigation was based on the premise that arsenic is a reliable

*Note: To avoid the somewhat tedious and artificial terminology that has developed over the years in referring to gold, silver, gold-silver, and silver-gold deposits (see Ferguson, 1929), the term "precious metal" will be used in this report to denote a mine that produces gold and/or silver.

guide to precious metal mineralization in epithermal veins in Tertiary volcanics of the Basin and Range Province.

Arsenic forms stable oxidized compounds in the soils of the region, and can be determined by a simple laboratory method that permits large numbers of samples to be analyzed rapidly. Gold and silver methods of analysis are tedious, and the behavior of the two during vein oxidation and the soil forming process is extremely unpredictable. In other words, one may not find gold and silver values in the soil over an important precious metal deposit, whereas arsenic might faithfully reveal the presence of an ore shoot. Another major advantage to arsenic is that it is apparently more widespread in the ore shoots than the precious metals themselves. The result is that arsenic presents a larger "target" to the geochemist in laying out sample site patterns.

A 500-foot square grid of 259 soil samples was collected over the entire district during the reconnaissance phase of work. Laboratory analysis revealed several arsenic anomalies*, several of which explained due to worked-out ore shoots beneath. However, two interesting anomalies were obtained over incompletely prospected ground; one on Silver Hill, and a smaller one on the south slope of Middle Hill. Detailed sampling was done on a 100-foot square grid in these areas, in order to provide a basis for comparison with a 100-foot grid of orientation samples that had previously been collected over the sub-outcrop of a known productive vein, the Humboldt-Silver Lining, on Humboldt Hill. This detailed work substantiated the reconnaissance geochemistry, and two areas of anomalous arsenic values were concisely defined.

*Note: For the purpose of this report, a geochemical anomaly is an abnormally high concentration of metal in soil, and is presumed to be related to mineralization.

Property acquisition was completed during the fall of 1964. Early snows and a prolonged winter delayed detailed geologic mapping of the surface until May of this year, when Silver Hill was mapped on a scale of 1" = 200', using transit and stadia methods.

This report summarizes Great Basin Exploration Company's activity in the area to date.

LOCATION

The Aurora mining district is in southwestern Mineral County, about three miles from the California state line in a low group of hills known as the Brawley Peaks. The district is comprised of about four square miles in an area elongate north-south about two and one-half miles, and one and one-half miles wide, centered on NW1/4 Sec. 19, T. 5 N., R. 28 E., M.D.M. Figures 1 and 2 on the following pages show the location of the district. Greater detail in the area immediately around Aurora may be seen on Figure 3, p. 6, showing the location of Silver Hill. Silver Hill is in the south central portion of the district, on the north slopes of Brawley Peaks at an elevation of just over 8000 feet above sea level.

Aurora is 95 miles airline southeast of Reno, and is accessible by four different routes, which are given here in order of decreasing advantage to the traveler from Reno. The best route from Reno is from the north via Wellington and Sweetwater on paved State Highway 22, to the turn-off at the East Walker River, thence 12 miles to Fletcher on a good graded gravel road along Rough Creek. Fletcher is at an elevation of about 6000 feet, and the road is open virtually the year around. From Fletcher, the 6 miles of road to Aurora progressively worsens, until the last mile from Aurora to Silver Hill is open to passenger car traffic only during the best of weather. This

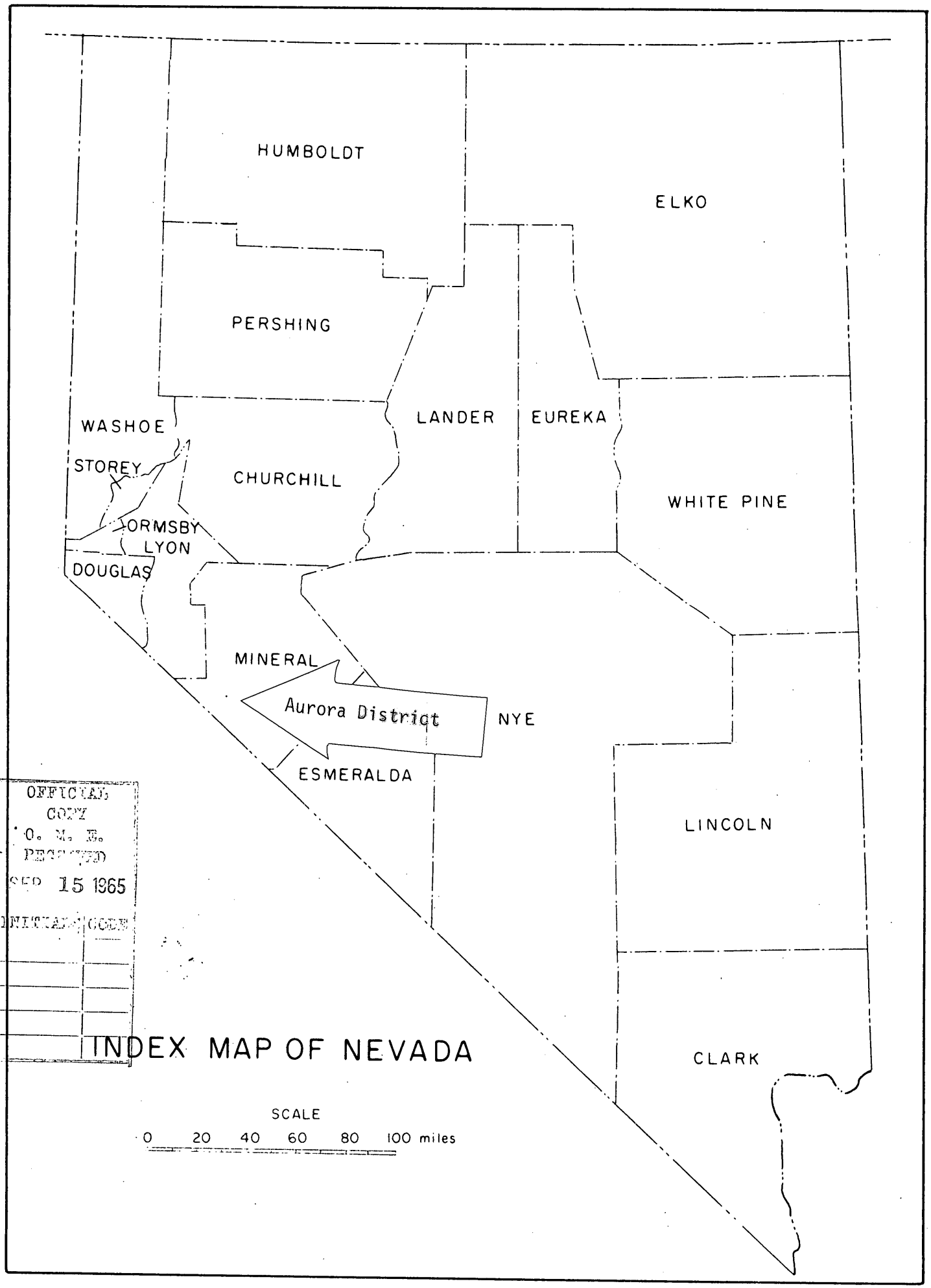

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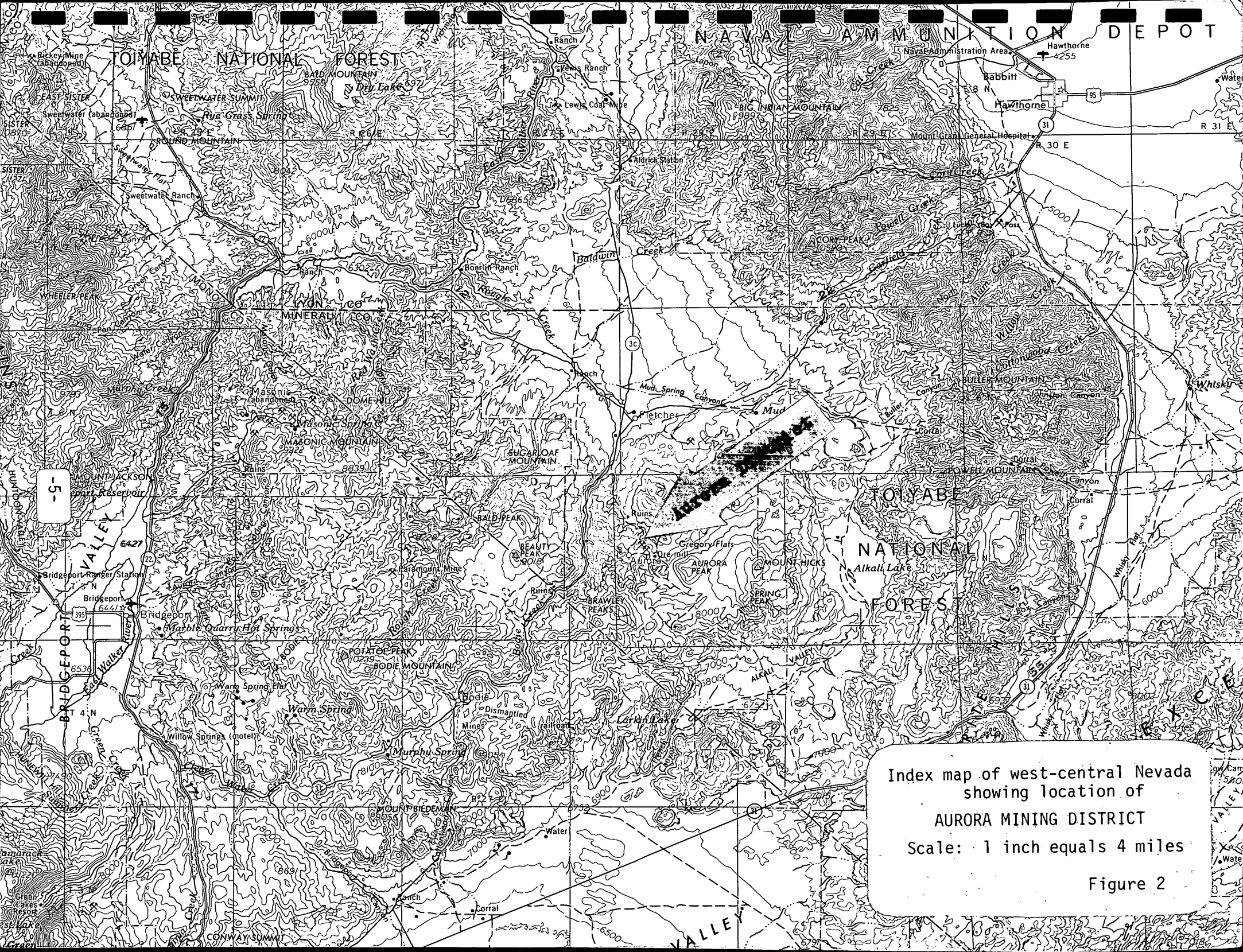
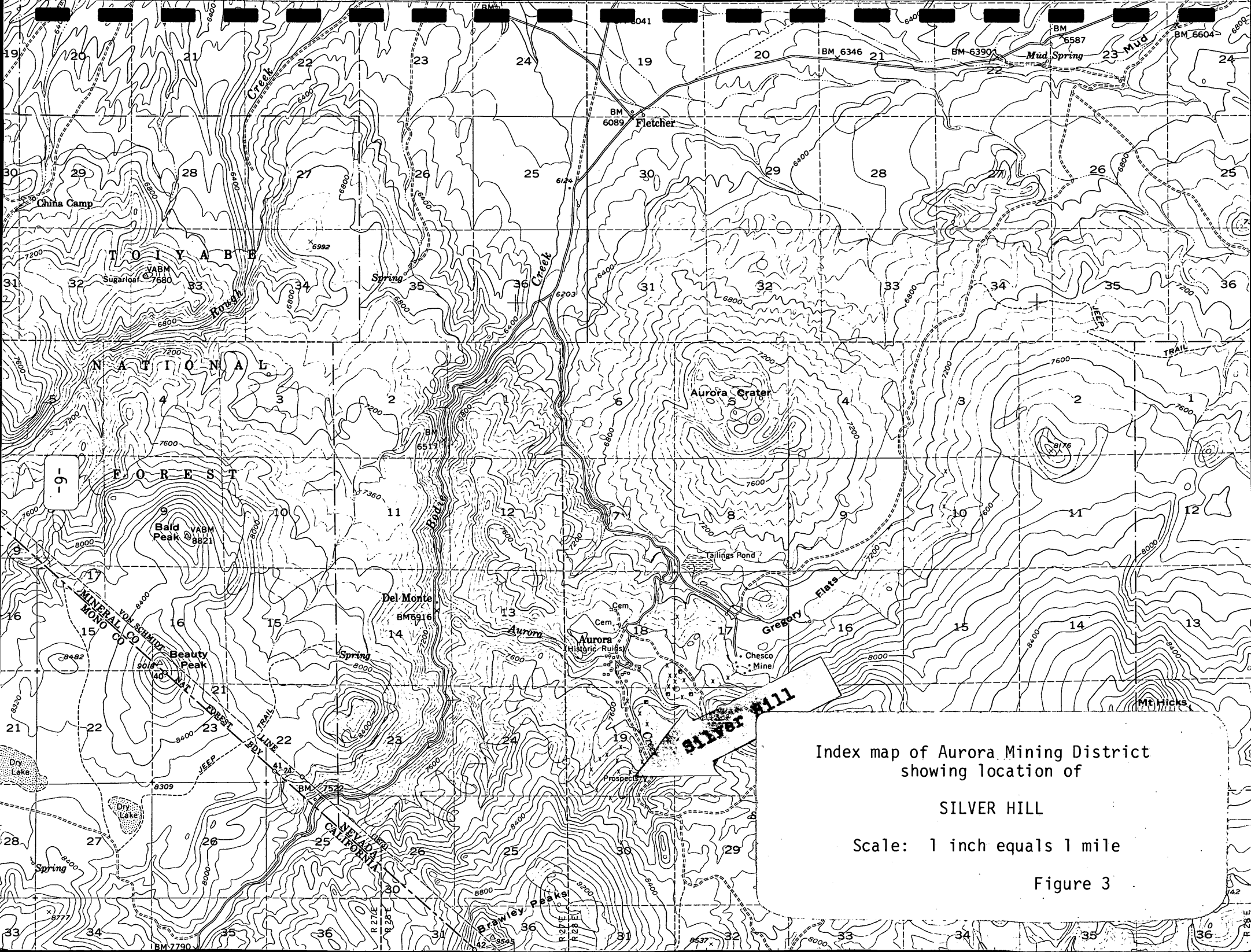
Figure 1



Index map of west-central Nevada showing location of AURORA MINING DISTRICT

Scale: 1 inch equals 4 miles

Figure 2



Index map of Aurora Mining District showing location of

SILVER HILL

Scale: 1 inch equals 1 mile

Figure 3

road could easily be improved for mine haulage, although provision would have to be made for snow removal during the winter, at least for the last three or four miles of road above the 7000 foot contour. A second route into the district is from the east at Hawthorne 22 miles to Fletcher via good graded road over Lucky Boy Pass. Travel from Reno via the Hawthorne route takes only slightly longer than via Wellington, and provides a pleasant alternate access to and from Aurora.

A much less dependable route to Aurora is from the west at Bodie on State Highway 3c, a gravelled road up Bodie Creek Canyon that is washed out as often as not. A fourth, presently impassable route into Aurora is from the south, where a dirt road turns off paved State Highway 31 at the California state line, crossing Alkali Valley, up over the pass between Brawley and Spring Peaks, and down Esmeralda Gulch and Silver Hill, a total of 10 miles off the pavement. This last route could easily be restored, but has never been popular because of the 8500 ft. pass, which is closed except for the summer months.

SITUATION

The climate of the area is that typical of the western Great Basin. At the elevation of the old Aurora townsite (7400 feet above sea level), temperatures range from a minimum of 10° to 20° below zero (F°), and rarely exceed the mid-nineties in the hottest of summer weather. Less than half of the 7 to 8 inches of annual rainfall is in the form of winter snow. Most of the remainder is in downpours during late summer thundershowers.

Vegetation in the area is more abundant than in the surrounding region, although much of the district is simply covered with sage brush. Pinon pine and juniper are quite common, and several good stands of aspen can be

seen on the slopes of Brawley Peaks, where springs occur near the head of Cottonwood Canyon.

No timber is suitable for saw lumber. Adequate water is available at a number of shafts and tunnels, and at the above-mentioned springs. At present the nearest source of electricity is the Mineral County Power Company line at Del Monte, a mile and a half down Aurora Creek in Bodie Creek Canyon.

HISTORY OF THE DISTRICT

Early Period, 1860-1864

The Aurora mining district was discovered on August 22, 1860, by a party of three prospectors who had worked their way into the district from Walker Lake to the northeast. Messrs. J. M. Braly, J. M. Cory, and E. R. Hicks were prospecting for silver, and had camped in Esmeralda Gulch the night before, very probably at the spring in the east center of the Hornet No. 1 claim. Hicks (who according to contemporary accounts was half Cherokee Indian) was apparently the hunter for the party and went out in the morning to provide for the camp. He crossed over the prominent croppings of the Esmeralda vein, and took several fragments of vein material back to camp, where his companions immediately identified the silver mineral argentite. The party spent three or four days completing locations on the Esmeralda and "Winnemucca" veins on Silver Hill. The "Winnemucca" ledge is mentioned in several early accounts, and is probably the vein which has subsequently become known as the Spotted Tiger. Extremely rich specimens of gold and silver ore were collected from outcrops of the prominent ledges during location work, which were taken to Virginia City for assay. A great rush began, and by the end of October, 357 mining claims had been located, and a tent city of some 1000 persons had become established at the head of

Esmeralda Gulch, south of Aurora in a locality unprotected from the weather. This settlement, the district itself, and the county as well*, all took the name Esmeralda from the first location on Silver Hill. The name also was favored for the State by almost all delegates to the Nevada Statehood Convention, apparently failing because of the peculiar aversion of Great Basin citizens to Spanish names. Mining became concentrated in Sections 18 and 19, and the town of Aurora sprang up the following summer, in a more protected location close to the activity. It is unlikely that Aurora ever had more than 6,000 residents, the peak population of 1863-64. Seventeen stamp mills were constructed during this period (Wasson, 1878, p. 46), the ore being treated by the inefficient Washoe Process (amalgamation in pans heated by steam). The largest of the mills was the Real del Monte, in Bodie Canyon, with 30 large stamps.

The early production was obtained from mines on four prominent topographic features: Silver Hill, Middle Hill, Last Chance Hill, and Humboldt Hill (see Plate 1), most of it before 1865. Various sources indicate that at least $20 million was produced during the period 1861-1864, of which at least three-fourths was in gold. The price of gold during the period 1860-1864 was $20.67 per troy ounce, with silver at 1/16th of this figure, in the traditional monetary ratio of gold to silver, at $1.29 per troy ounce.

Therefore, when considering past production figures, one must keep in mind the inefficient metallurgical extraction of the day and the old, low "American Standard" price of gold. The value of bullion produced from the same ores today would be more than double the $20 million yield formerly yielded.

and the higher ratio

*Note: Mineral County was created out of the northern portion of Esmeralda County in 1911.

Mines that produced extensively during the period 1860-1864 are:

Humboldt Hill	Last Chance Hill
Humboldt	Last Chance
Silver Lining	Wide West
Martinez	Prospectus
Juniata	Real del Monte
Middle Hill	**Silver Hill**
Summit	Antelope
Live Yankee	Utah-Cortez
Durant	Old Esmeralda-Radical
Sitting Bull	Bald Eagle-Spotted Tiger

Detailed production records for this early period are all but lacking, but it seems likely that each of the four areas listed above produced between $4 and $7 million, with Silver Hill being perhaps the largest producer and Middle Hill probably the smallest of the four.

An interesting account by H. G. Clarke, E. M. (1882, p. 133), who was one of the few technically trained individuals to work in the district and tell of early conditions, emphasized that the Aurora "boom" lasted only for two years, until 1864, when all the rich ore at the surface became exhausted. A quotation (Clarke, 1882, p. 134) illustrates conditions:

> "...The mineral occurs in the veins in bonanzas or what are locally called rich chambers. The quartz for long distances will be barren, or nearly so, though the walls continue good, then suddently it will become highly mineralized with native gold and silver and some sulphide of silver; at the same time the walls widen out, and the vein is filled from wall to wall with the richest kind of ore....."

Another comment (Clarke, 1882, p. 135) is relevant:

> "...After the rich chambers of ore had become exhausted and the money had been paid out in dividends and expensive law-suits about titles, etc., work on the mines was abandoned without any attempt at prospecting the veins for new bonanzas....."

He goes on to describe a vein on Silver Hill which was being developed under his direction for an eastern company. The vein, on the Cortez and Utah claims, had a normal width, when not in bonanza, of about 3 feet. In the 1500 feet of the ledge on the Utah claim, five bonanzas were found which produced a total of $5 million from rich ore. On the Cortez portion of the vein, a chamber was opened, extending from the surface nearly to the 150 foot level, that was 50 to 75 feet long, the walls of the vein widening out to 20 and 25 feet apart. This chamber yielded $2 million, and was worked in 1862 and 1863.

Farther down Silver Hill to the north, the Antelope was also a major producer, most of the ore being of relatively high grade, averaging $150 per ton, while some ran as high as $300 per ton (Mining and Scientific Press, Sept. 7, 1863).

Probably the largest single ore shoot discovered in the district was the Wide West bonanza, found at a depth of 60 feet on Last Chance Hill in 1862 (Wasson, 1878, p. 45).

Late in 1864, decline of the district was clearly evident, and half the population left during the winter (Thompson and West, 1881, p. 418). The easily developed surface ores were exhausted, extensive litigation had developed over properties, management had declared excessive dividends leaving the companies in poor finances, and promotional schemes had been detrimental to the district's reputation from the point of view of the investor (Wasson, 1878, p. 48). Coupled with these factors, most exploration in depth had been discouraging, and phenomenal discovery of the "Big Bonanza" of the Comstock Lode proved a powerful lure to Aurora's inhabitants. Most contemporary journals and accounts mention the attractions of the Comstock.

1865 to the Present

Several attempts at deep development were made, two of them on Last Chance Hill. The first was by eastern capitalists, and comment of the Nevada State Mineralogist in 1866 seems singularly perceptive today (Stretch, 1867, p. 31):

> "...The Philadelphia Mining Company, an Eastern incorporation, have purchased property on Last Chance Hill, and are down with their shaft 280 feet (1866). Their intention is to continue sinking until the dip of the veins brings them into the shaft at an estimated depth of about 470 feet. It is much regretted that this, which will be the deepest shaft in the district, was not located on a more promising property, as its success will have a powerful influence, for good or evil, on the mining prospects of Aurora....."

The project met with failure and was abandoned in 1868. An even more ambitious attempt at deep development under Last Chance Hill was made by the Real del Monte Company, incorporated with $5,000,000 in October of 1877 (Whitehill, 1879, p. 68). The Real del Monte shaft reached a depth of 900 feet in 1881, but encountered more water than could be handled with the pumps available, and the project was abandoned early in the decade of the eighties.

Still later English capital attempted to unwater the workings of the Real del Monte to the 800 level. Failing this, development work was done on the 400 level, and the Humboldt shaft was sunk to a depth of 400 feet. Again, results were unsuccessful, and the project was abandoned in 1892 (Hill, 1915, p. 132).

Aurora, along with the other precious metal mining districts in the Great Basin, languished through the decade or so after the "panic" of 1893, when the mining industry of the area entered its greatest period of depression prior to the discovery of Tonopah and Goldfield.

In 1901-02, as the cyanide process came into use, tailings from some

of the early milling operations were re-treated with modest success (Vanderburg, 1937, p. 14).

During the period 1906-1911, several old mine dumps were treated in a 60-ton custom mill operated by J. S. Cain. The plant employed amalgamation with subsequent cyanide leaching of the amalgamation tailings (Vanderburg, 1937, p. 16).

In 1912, the Aurora Consolidated Mines Company began developing the Humboldt Hill properties at depth. This deep development work was done by driving a long tunnel in from the north from the Prospectus ground, the claim giving its name to the project. A 500-ton mill was constructed, and several engineers estimated nearly a million tons of low grade ore averaging $5.00 per ton, principally on the Humboldt and Silver Lining veins. The operation was an attempt to come in from beneath, mining low grade, then stope up into old bonanza workings and simply re-mine the vein, taking pillars (which were numerous), fill, cave, etc., for milling ore.

Goldfield Consolidated Mines Company acquired the Aurora Consolidated property in 1914, and mined for three years during 1915-1917. Production increased during the three years from slightly under 150,000 tons to over 175,000 tons per year, while average values fell from $3.73 to $2.32 per ton treated (Vanderburg, 1937, p. 15). Almost $2,000,000 in gross values were obtained, but Goldfield sustained a net loss on the operation. They were able to keep costs down to $2.92, but there was no hope of continuing this in the war-time inflation (Minerals Yearbook, 1918, p. 543), and the $2.32 per ton values were less than half what Aurora Consolidated Engineer's had estimated for the project. A last unsuccessful attempt was made to develop deep ore under Humboldt Hill, this time on the Juniata claim, making the Prospectus tunnel by far the longest tunnel in the district, over 1-1/4

miles long. The Aurora Consolidated project was suspended in 1918.

During 1949 and 1950 the H. B. Chessher interests of Reno, Nevada produced an undetermined small amount of gold and silver from shallow workings on the Juniata claim in the Chessco mine (Minerals Yearbook, 1949, p. 1537; Minerals Yearbook, 1950, p. 1552).

Since 1950, there has been no mining activity in the district, and the Flying M Ranch, one of the larger cattle companies of western Nevada, is using the area as open cattle range.

Couch and Carpenter (1943, p. 100) show a total production for the district of 669,962 tons of ore valued at $31,409,013 for the period 1860-1940. Other, less authoritative, estimates are from $27 million to $40 million.

PROPERTY OWNERSHIP

All property of importance to exploration work described in this report has been acquired by Great Basin Exploration Company on Silver and Middle Hills.

Company Held, by Lease and Option

Junquist group.--Four patented mining claims on Silver Hill were leased with an option to purchase from Mr. F. A. Junquist of Los Angeles, California.

Radical, Mineral Survey No. 37
Bald Eagle, Mineral Survey No. 39
Monarch, Mineral Survey No. 4220
Seminole, Mineral Survey No. 4220

"Term: 10 years.

Price: $50,000. Initial payment, $5,000 due April 1, 1966. Thereafter equal annual payments of $5,000.

Royalties: 10% of gross bullion. Minimum royalty payment of $300 per quarter, payable the 21st day of

January, April, July, and October of each year throughout the term of the lease. Royalties apply upon annual payments and purchase price.

Work obligations: None.

Cancellation: Upon 30 days notice."

Relich group.--Six patented mining claims on Silver Hill were leased with an option to purchase from Gabriel and Violet Relich and Victor and Virginia Relich of El Cerrito, California.

Spotted Tiger, Mineral Survey No. 38
Black Hawk, Mineral Survey No. 4220
Wyandott, Mineral Survey No. 4220
The Gladiator, Mineral Survey No. 4220
Silver Hill, Mineral Survey No. 4220
Virginia, Mineral Survey No. 4221

"Term: 10 years and 6 months.

Price: $100,000. Initial payment, $10,000 due January 31, 1966. Thereafter equal annual payments of $10,000. An initial payment of $500, already made, in consideration of the lease and option agreement, does not apply to payments or purchase price.

Royalties: 10% of gross bullion. Minimum royalty payment of $300 quarterly, payable the 20th day of February, May, August, and November of each year throughout the term of the lease. Royalties apply upon annual payments and purchase price.

Work obligations: None.

Cancellation: Upon 30 days notice."

Company Held, by Location

Five lode locations were made in two groups; three claims were staked in the Hornet Group on the east slope of Silver Hill, and the Wasp Group consists of two claims on the south slope of Middle Hill.

Hornet group.--The Hornet group of three contiguous mining claims adjoins the Virginia patented claim:

Name of claim	Location date	Discovery work done	Recorded	Proof of Annual Labor
Hornet No. 1	12 July 64	yes	yes	filed for current year
Hornet No. 2	12 July 64	yes	yes	" " " "
Hornet No. 3	18 May 65	yes	yes	due September 1, 1966

All open ground on Silver Hill of interest to Great Basin Exploration Company has been located.

Wasp group.--The Wasp group of two contiguous mining claims adjoins the Good Hope and Summit patented claims, and is contiguous with the Hornet group:

Name of claim	Location date	Discovery work done	Recorded	Proof of Annual Labor
Wasp No. 1	25 June 64	yes	yes	filed for current year
Wasp No. 2	18 May 65	yes	yes	due September 1, 1966

All open ground on the south slope of Middle Hill of interest to Great Basin Exploration Company has been located. There is no patented ground of interest in this area.

Other Property

No foreign ground is known to exist on Silver Hill or the south slope of Middle Hill. Great Basin Exploration Company has unity of title to the single block of claims shown on Plate 3 accompanying this report.

GEOLOGY

General

The Aurora mining district is near the western margin of the Basin and Range Province. Inasmuch as most of the rocks in the immediate area are Miocene or younger, regional studies must be relied upon for an understanding of early geologic history. The report by Ross (1961) on Mineral County is

invaluable, and the structural interpretations of Ferguson and Muller (1949) shed much light on tectonism of the region. An analysis of structural control of the Aurora vein system was recently made by Green (1964). The brief descriptive account of the geology of the Aurora district by Hill (1915, p. 133-150) is probably the single most useful geological reference. The following synthesis of geologic events draws freely upon these four sources.

Older Sediments

About 30,000 feet of calcareous clastic and volcanic rocks of Triassic and Jurassic Age were deposited in the western portion of the Cordilleran geosyncline, a great marine trough that extended from north to south through Nevada in late Paleozoic and Mesozoic time. One and one-half and three miles southeast of Aurora are two large outcrops of the Triassic Excelsior formation, one of the geosynclinal sedimentary units, which consists of volcanic flows and tuffs, with a minor amount of calcareous, tuffaceous sediments.

Intrusive Granitic Rocks

The geosynclinal sedimentary sequence was intruded by granitic rocks, chiefly quartz monzonite, which probably are small outlying satellitic intrusives of the great Sierra Nevada batholith of late Cretaceous or early Tertiary Age. This pluton was emplaced at the culmination of geosynclinal sedimentation, volcanism, and structural deformation. The exposures of Excelsior formation cropping out southeast of Aurora are both intruded by facies of the granitic rock. At Willow Creek, a mile and a half southeast of Aurora, the rock is a porphyritic granite with large pink orthoclase phenocrysts.

In the 100 square mile area centering at Aurora, exposures of the

older sediments and intruded granite are so scarce that little can be said of any mineralization that might be related to the granitic intrusions. Elsewhere nearby, these intrusives give rise to important tungsten, iron, and copper mineralization, generally at or near the igneous contacts.

Aurora Volcanics

The Mesozoic sediments and Cretaceous granite were eroded to a surface of moderate relief early in Tertiary time, and intermediate to felsic volcanic rocks were erupted widely over the surface during Oliogocene or Miocene. Hill (1915, Plate 14) mapped these volcanics as "biotite-quartz latite and associated andesite porphyries". Green (1964, p. 14) named them "Aurora volcanics", an originally intermediate to siliceous rock that has been generally propylitized and sericitized. Both Hill and Green believed that some of the intermediate rocks were intrusive, but were unable to distinguish the rocks well enough to delimit them in mapping.

A relatively fresh specimen of Aurora volcanics collected in Esmeralda Gulch on the Hornet No. 3 claim is a porphyritic andesite showing incipient propylitization under the microscope.

All of the veins of the Aurora district are developed in Aurora volcanics.

Bodie Canyon Volcanics

A sequence of younger rhyolitic tuffs and flows overlies the Aurora volcanics in a pronounced unconformable relationship. Green (1964, p. 16) named these felsitic rocks "Bodie Canyon volcanics". The hiatus at the base of the Bodie Canyon sequence probably represents the interval of time during which the Esmeralda formation was being deposited elsewhere in the region. The Esmeralda formation, of Miocene and Pliocene Age, is a lacustrine and continental fluvial deposit widespread throughout western Nevada. The complete

absence of the formation in the Aurora district is indirect support for the concept of Wisser (1960) that doming immediately preceeds and accompanies mineralization in most important Cordilleran precious metal mining districts. Similar doming nearby at Goldfield causes the Esmeralda formation (called Siebert formation in this district) to wedge out over the most productive central portion of the camp, and a similar relationship is noted in most precious metal districts of the region where evidence has been preserved from erosion.

There is mounting evidence to suggest that, in western Nevada precious metal districts from the Comstock Lode to the southern part of the state, the vein systems were mineralized contemporaneously with the deposition of the Esmeralda formation. Actually, the "formation" is a series of different deposits lain down in isolated basins at about the same general time and under the same climatic conditions during the Miocene and Pliocene. The relatively unaltered flow rocks of the Bodie Canyon volcanic sequence were deposited directly on the old, uneven topographic surface eroded on the Aurora volcanics. The Bodie Canyon volcanics are predominately rhyolitic flows and associated tuffaceous rocks, but minor amounts of extrusive, and possibly intrusive andesite are also found.

No known mineralization occurs in the Bodie Canyon sequence, and further doming after its deposition re-exposed the underlying mineralized Aurora volcanics in a distinct three-sided "window" or "keyhole", with unmineralized Bodie volcanics flanking the district to the west, north, and east. Several vein systems simply go right under the younger volcanics at the contact. Casual discussions often turn to hidden exploration possibilities under the younger cover at Aurora. It is interesting to note that the nearest exposure of pre-Esmeralda rocks to the west happens to be the dome-like exposure of

andesites which embrace the veins at Bodie, the nearest important precious metal mining district in this direction.

According to Hill (1915, p. 146) the rhyolite series is made up of a number of relatively thick flows, all of which are glassy. They range in color from gray through green to purple. Some of them appear to be tuffaceous, but the majority are typical flow rhyolites. Flakes of biotite are seen in all of these rocks, and quartz can usually be detected with the unaided eye.

The Bodie Canyon volcanics are probably Pliocene in age. A period of further uplift and erosion followed the deposition of the Bodie Canyon volcanics, followed by widespread Basin and Range faulting which block-faulted the mountain ranges upward into their approximate present positions, and downdropped the valleys. Pliocene sedimentation continued in these intermontane depressions into the Quaternary in the form of alluvial valley fill.

Quaternary Basalt.--During Basin and Range tectonics, faulting locally tapped the earth's crust deeply enough to encounter molten material, which erupted through to the surface in basaltic volcanism. Such a volcanic eruption occurred just north of the district at Aurora Crater. The basalt is a very fresh vesicular black rock with small green olivine crystals, much the same as any number of other similar recent basalt eruptions in western Nevada. The volcano appears to be youthful, for little soil has developed on it, and erosion has not appreciably modified the characteristic cone like form.

Quaternary gravels.--Throughout the district, stream bottoms contain sedimentary detritus being transported out into Bodie Canyon, and the major valleys nearby are alluviated with thick sequences of young valley gravels.

A peculiar stratified formation consisting of volcanic material is seen at several places, apparently a recent wind-blown deposit, which has locally

been re-worked by water (Hill, 1915, p. 146). This material is over 15 feet thick as shown by exposures over caved mine workings on Humboldt and Last Chance Hills, and is probably the equivalent of a similar unit described in detail by Lundby (1957, p. 27) immediately to the north-west in Bodie Creek Canyon. Here, widespread rhyolitic ashfall accumulated in a relatively thin layer, which was swept into local depressions by concurrent rainfall and stream action. This ashfall is too thin and scattered to portray on the geologic maps. It may be related to an early phase of the basalt eruptive activity. Great Basin basalt volcanoes often erupt siliceous ash, and many of the pumice deposits of the region originated in this manner.

ORE DEPOSITS

Structure of the Veins

The veins of the Aurora district are found only in the andesitic flows of the Aurora formation. The veins nowhere cut the overlying rhyolitic rocks of the Bodie Canyon formation, although recurrent (post-ore) movement along some of the vein-faults may offset the younger volcanics.

Two principal vein systems are evident (Green, 1964, p. 20), which appear to be essentially contemporaneous in age; just before or during metallization. One prominent fault system is aligned approximately north-south. Three very prominent structures of this trend are the Esmeralda, Johnson, and Prospectus faults (see Plate 1). The very southernmost portion of the Esmeralda fault is strongly mineralized, forming the broad Esmeralda and Radical lodes which first drew attention to the mineralization of the district. This system of faulting and veining will be called the "northerly" system for the sake of convenience. The "northerly" system of faults usually are vertical, and rarely contain mineralization of significance. However, a

close time and space relationship must have existed between the "northerly" system of faults and mineralization, for no important mines have been developed more than 500 feet away from one of these structures. Most good ore is within 300 feet of a "northerly" fault. These structures may have been the channels for ore solutions rising from depth. Movement along the northerly system is mainly strike-slip, with right lateral offset. The Humboldt vein is offset by the Prospectus fault a distance of several hundred feet northward on the west side of the fault, where it is called the Prospectus lode.

The second system of faulting, which contains virtually all of the important ore shoots of the district, trends from N. 40° E. to N. 50° E., with a surprising number of compass bearings of strike being exactly N. 45° E. Dips are from 20° to vertical in a southeasterly direction, with a few steep dips to the northwest seen from place to place. The predominate dip is 40° to 60° to the southeast. Slickensides along these structures indicate the offset to be mainly dip-slip. For the sake of convenience, further reference will be made to these faults as the "northeasterly" system.

Character of the Veins

The veins of the Aurora district vary from a few inches in width to broad structures almost 100 feet thick from wall to wall. Widths of 2 to 4 feet predominate, and the structures are relatively regular and continuous, often persistent for several hundred feet along strike. The veins branch and split profusely, sending out irregular stringers into the footwall, particularly where dips are steep. The northeasterly vein system usually widens abruptly at the juncture with the northerly fault-vein system, at least to judge from relationships as viewed in plan. This thickening of vein structures at intersections, as viewed in plan, does not appear to

be accompanied by a corresponding increase in precious metal content, although the miners in the district certainly seemed to prospect such zones with uncommon vigor.

Less clearly understood is the importance of hanging wall branches from the southeast dipping veins. This structural situation is very productive in other Great Basin precious metal camps. At several places (for instance on the Spotted Tiger vein) one gains the impression that steep hanging wall branches may be a favored place for ore deposition; just above the vein intersection.

The veins consist mainly of fine-grained white quartz which is usually milky in color and often has a stoney porcelain-like texture. Banding, crustification, comb structure, and other evidence of open space filling are present though not pronounced, and lend support to the obvious conclusion that the veins are epithermal in origin. Small cavities are everywhere present, and they are often lined with myriad small quartz crystals, the beauty of which is marred by limonitic iron staining.

According to Hill (1915, p. 148) the rich ore is characterized by irregular dark wavy streaks that consist of quartz, adularia, argentiferous tetrahedrite, and small amounts of pyrite or chalcopyrite, together with a soft bluish-gray mineral supposed to be a combination of gold and possibly silver with selenium. Free gold is often seen in the ores, and was especially rich in the surface ores worked in the early days. Hill (1915, p. 150) describes the ore shoots themselves as follows:

> "...In the majority of the veins it is understood that the rich ore streaks, ranging from a fraction of an inch to 6 inches in width, were as a rule found near the walls, particularly the hanging wall, and that they were not continuous along the veins for any considerable distance."

It is almost certain, however, that the barren-looking white quartz, where it shows even a slight suggestion of the bluish color, contains gold. . . . . ."

"...The veins are said to have been in general wide in the richer portions. This was particularly the case in the Wide West vein where some of the stopes were as much as 60 feet wide, though the leaner portion of the vein between the stopes ranged from 6 to 10 feet in width. . . . . ."

Tenor of the Veins

The grade of ore mined in the past varied from a few dollars per ton to over a thousand dollars per ton, depending upon the mining method and the availability of treatment facilities. Much of the early high grade production was from $150 to $300 per ton at the old prices, and the pockets of ore were of 4,000 to 6,000 tons. Ore deposits of this size and grade would produce gross bullion worth $1 to $2 million operating under today's technology and economics. Such deposits often were contained within an envelope of material of lower grade. If an ore deposit of this kind were to be found today, more ultimate profit might be made by attempting to also mine the surrounding low grade ore. However, such good conservation practice would necessarily be weighed against the economics of mill construction and operation.

Relationship of Gold to Silver

A lively discussion always develops as to gold:silver ratios in a precious metal mining district. Such considerations are particularly relevant today because of shortening supplies of silver and gold. Hill (1915, p. 150) estimates a district average gold to silver ratio of 1 to 5. That is, for each ounce of gold, 5 ounces of silver is produced. This figure seems fairly reasonable for a district average, but evidence suggests that

the northern portion of the district was richer in gold, and the southern portion relatively high in silver. Spurr (1923, p. 686-694) summarizes the results of an extensive sampling program at Aurora by saying that the gold: silver ratio in the north is 1 to 2 on Humboldt Hill, while on the Old Esmeralda the ratio is 1 to 35 to 46 by weight. At the present prices of gold and silver, a ratio of 1 to 27 by weight is the point at which silver becomes more important than gold from the standpoint of dollar value rather than weight of metal. This relationship of one portion of a district having a different gold:silver ratio than another is quite common, and separate portions of the same vein often show different gold:silver ratios. Two factors are usually discernable. One, the earlier formed vein material is commonly more rich in silver. Gold is introduced later by different solutions that may or may not faithfully follow the same vein, or brecciated vein, that was earlier enriched in silver. A second factor is that silver and gold behave differently during oxidation, in such a manner that one or the other, or both, may be enriched near the surface, giving a false impression as to the original relationship. At Seven Troughs in Pershing County for example, a number of silver veins are commonly thought of as gold deposits, when actually the high gold values are purely a surface phenomena related to residual enrichment of gold during oxidation of the primary silver ore.

Genesis of the Ores

The American student of ore deposits would, without hesitation, assign the Aurora ores to Lindgren's (1933, p. 453) "Gold-selenide" category of epithermal deposit. European geologists would propose a similar classification envisioned by Schneiderhöhn (1955, p. 120), the "Redjang Lebong" type of "sericitic-calcitic-siliceous gold and gold-silver ore with selenium".

Some deposits of this type are more noted for silver than for gold. Important examples of this category of precious metal deposit are:

Guanajuato, Mexico
Tonopah, Nevada
De Lamar, Idaho
Waihi, New Zealand
Republic, Washington
Redjang Lebong, Sumatra

Nothing has been learned of the Aurora veins that would contradict this classification, and a few generalizations might be made on the basis of observations made here and comparison with similar deposits of this category elsewhere:

(1) The ores are formed by ascending hydrothermal solutions in mid to late Tertiary, and favor andesitic host rock.

(2) Propylitization is a common related form of wall rock alteration, particularly in andesite. Propylitic alteration consists of abundant development of chlorite and pyrite, and sometimes also epidote; in places it is accompanied by the development of carbonates. The rock, which assumes a dull green color, usually directly adjoins the ore-bearing vein structure.

(3) More intense alteration related to ore is in the form of addition of potash, resulting in sericitization of wall rock adjacent to ore, and presence of sericite in the vein itself. Adularia may be closely related to the ore minerals.

(4) The ores are deposited in a relatively shallow zone near the surface, and exploration at depth encounters low grade calcitic vein material. NG

(5) Surface enrichment of gold is usually richest near the bottom of the zone of oxidation.

(6) Placers are rarely of importance, no matter how well exposed the vein croppings.

These generalizations, though in part unrelated, will help in interpretation of exploration possibilities of the district.

GEOCHEMISTRY

Geochemical methods have not been widely used in prospecting for precious metals. In the absence of rapid field tests for gold and silver and because, in some areas, these metals are subject to leaching and redistribution near the surface, arsenic has been the subject of much interest as a "pathfinder" element for precious metals. Epithermal gold and silver usually occur in association with arsenic, and stable secondary arsenic compounds commonly form during arid climate oxidation and weathering. Much work has been done in Africa (Hawkes and Webb, 1962, p. 360), and in Russia (Ginzburg, 1960, p. 208), but until recently little was known of the behavior of arsenic in soils over epithermal precious metal veins in volcanics in the Great Basin.

Cavender (1964) described the results of an exploration program at the Getchell Mine in north-central Nevada, where arsenic anomalies in residual soils shows a direct relation to gold-arsenic mineralization. Osborne (1963) has summarized the results of arsenic studies in soils at six representative Nevada epithermal precious metal districts; Comstock, National, Seven Troughs, Talapoosa, Tuscarora, and Wonder.

In this region, arsenic appears to accumulate as stable secondary compounds in soils developed over precious metal veins in volcanics. There is a relationship between the stability of arsenic and iron, since the presence of tri-valent iron is conducive to the oxidation of tri-valent arsenic. Furthermore, co-precipitation of AsO_3^{-3} with limonite and as $FeAsO_4$ (scorodite) is thought to be an important process in retention of arsenic in soils in an iron-rich environment (Hawkes and Webb, 1962, p. 360). There is usually abundant iron in Great Basin precious metal vein systems, as at Aurora, for the widespread propylitic alteration results in pervasive pyritization.

Arsenic anomalies in residual soils over Great Basin precious metal ore shoots are remarkably homogeneous, rarely showing erratic lows within a general high. Significant anomalies over known ore shoots indicate that they would easily be detected by a 500-ft. square grid, and that samples showing 50 to 100 ppm arsenic should be considered interesting. Background values are in the range 0-50 ppm arsenic, threshold values from 50-100 ppm, and anomalous values are over 100 ppm* (Osborne, 1963, p. 64).

A reconnaissance sampling program at Aurora was laid out on 500 ft. square grid, consisting of 259 sample sites marked off on an enlargment of a U. S. Forest Service vertical aerial photograph, as shown on Plate 2. Because of the horizontal distortions inherent in vertical aerial photographs, the positions of some of the sample sites may be as much as two hundred feet out of true position, but it is believed that the positions of adjacent samples, in relation to each other, is reasonably good. The samples were collected at uniform 8 inches depth, placed in "Caneco" waterproof paper envelopes, allowed to dry naturally on the shelf, and pulverized to minus 80 mesh. Arsenic determinations were done in the author's geochemical laboratory in Reno, using the method of Almond (1953).

Analytical results revealed that the arsenic anomalies are broadly related to the previously mined ore shoots. More detailed sampling is necessary to be sure of interpretations of relative size, intensity, and configuration of mineralization. For example, the small anomaly shown on Humboldt Hill only just barely indicates the presence of significant

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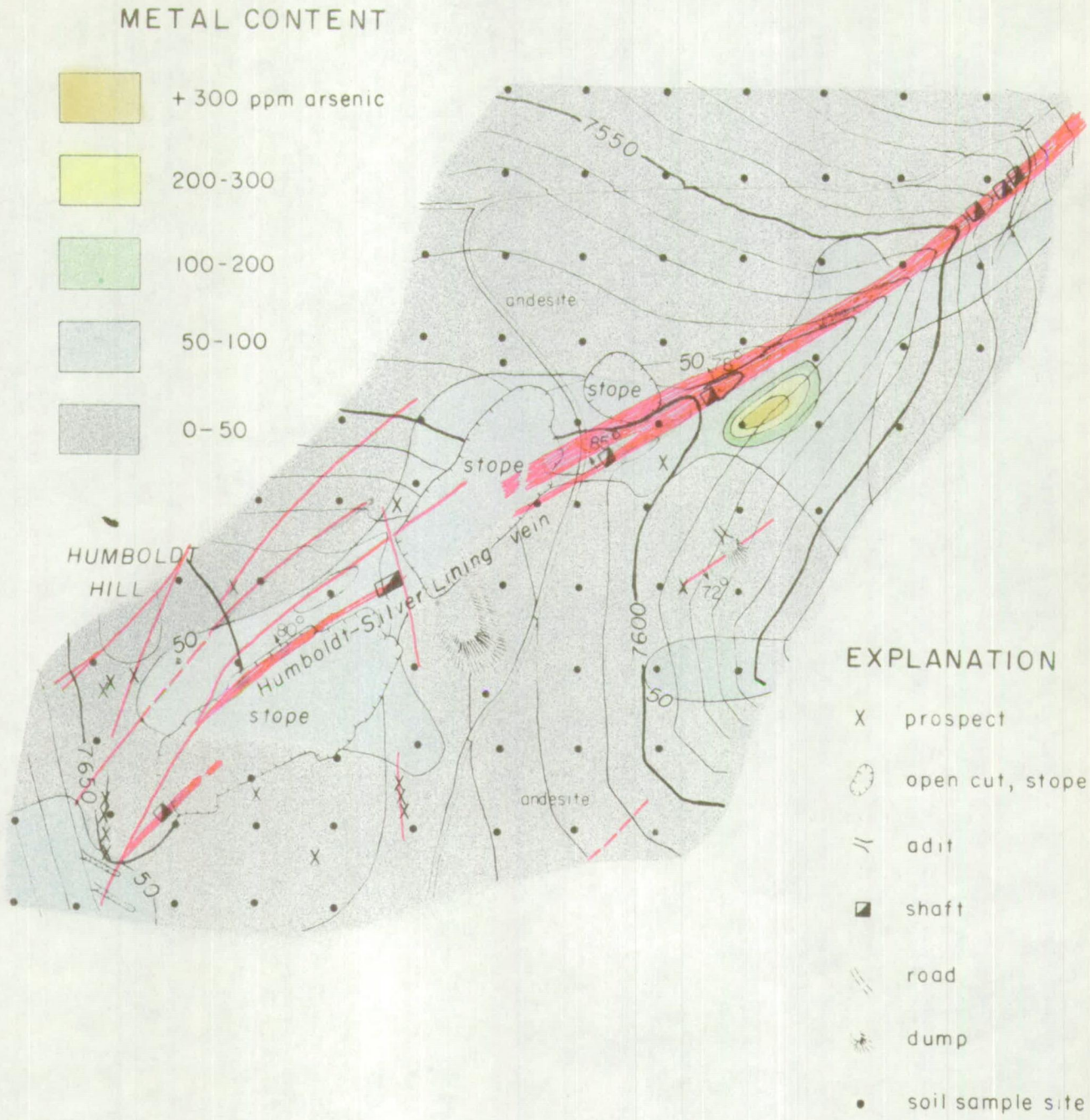
*Note: For the purposes of this report, these terms are defined as follows:
Background - normal abundance of an element in barren material.
Threshold - a range in values, greater than background, less than anomaly.
Anomaly - a high range in values, indicative of mineralization.

mineralization here. A detailed study of the Humboldt-Silver Lining area undertaken several years ago is shown on Figure 4, p. 30, and reveals the exact position of the ore deposit. A complication in this area is the unusual amount of water-worked ash fall (see p. 20) that mantles the slopes of Humboldt Hill, particularly on the hanging wall side of the vein to the north. This surficial layer of sedimentary material might mask a much more impressive arsenic anomaly. In any event, the detailed geochemical work here clearly illustrates the need for further sampling around any reconnaissance showing of 50 ppm or more of arsenic.

The reconnaissance program revealed significant anomalies on Last Chance Hill and Middle Hill. Silver Hill stands out as a particularly bold showing. Ground inspection of the southern portion of Middle Hill and Silver Hill indicated that underground development work is lacking or incomplete, and that untested exploration possibilities remain at shallow depth.

Detailed sampling was undertaken in both areas on 100-ft. square grid spacing. The reconnaissance work was substantiated in both cases, as shown on Plate 4. Large homogenous anomalies were obtained. The detailed sampling was checked for evidence of gold and silver, on the chance that small but significant quantities of the precious metals might have survived leaching during weathering and provide a further clue as to the best place for physical exploration work. A scattering of low values in both gold and silver was obtained, but no systematic distribution of values narrows exploration targets within the arsenic anomalies.

There is no reason to expect any gold or silver in the soil over ore, for it appears to have been cleanly leached from the surface zone throughout the district. Panning was never popular as a surface method of



Mineral County Nevada

Geochemical Map

HUMBOLDT HILL AREA

AURORA MINING DISTRICT

Scale: 1" = 200'

Brunton and tape control

Anthony L. Payne

September, 1963

Figure 4

exploration at Aurora, and placer production is negligible, in spite of the fact that all ores produced from the district lie at very shallow depth. Some of the ores actually cropped out (as witness the discovery of the district) where the veins are resistant to erosion and stand out in positive topographic expression.

It was therefore necessary to undertake detailed geologic mapping of the area in order to further delineate exploration possibilities. The results of detailed geologic work are discussed below.

EXPLORATION POSSIBILITIES

General

The southern portion of the Aurora district, due to its varied topography, has been subject to every type of underground exploration - vertical shaft, incline, trench, pit, drift, cross cut, raise, winze - there is no over-all pattern to serious development work, as is so often the case in precious metal mining districts. This complicated exploration history, coupled with complex geology and the need to accurately locate the geochemical sample sites in relation to known mineralization, made accurate topographic and geologic mapping necessary. The work was done in May of 1965, using transit and stadia methods, on a scale of 1" = 200', carrying contour interval of 10 feet. The results are portrayed on Plate 5, the Geologic Map of the Silver Hill area.

Exploration possibilities, based fundamentally on the results of the geochemical work described above (see Plate 4) can be seen at two localities; on the Wasp No. 1 claim on the south slope of Middle Hill, and on the Black Hawk and Wyandott claims on Silver Hill. For the sake of convenience, further reference will be to the "Wasp" and "Black Hawk" prospects.

Wasp Prospect

On the Wasp claim, a bold detailed geochemical anomaly was revealed in a poorly exposed area that appears to be moderately mineralized. The nearest production, which was modest, was on the Summit vein, a parallel vein structure some 500 feet to the north.

Three back hoe trenches to bed rock were excavated in the center of the Wasp anomaly. Mineralization was found in two of the trenches, but it is not possible to correlate what can be seen of the geology with what is known of the geochemistry.

One fact emerges from the detailed work to date. There are two prospect adits shown on Plate 5 near the east side line of the Wasp No. 1 claim at the 7950 and 8000 ft. contours. The lower adit goes into the hill above the apparent bed rock source of the geochemical anomaly. The upper adit may have cut the vein structure responsible for the anomaly, near the portal of the adit (see map), but the tunnel is far to the east, in a presumably barren portion of the vein. In any event, neither adit is any kind of test of the geochemical anomaly. Of course, neither was driven with this in mind. They are both apparent attempts to prospect large amounts of coarse vein float, which is believed by the writer to be derived from the Summit vein farther up the hill.

Not enough is known of the geologic structure of the Wasp area to design a program of exploration by drill holes from the surface. If exploration were to be undertaken at this time, it would be necessary to begin with underground work, probably by adit from the south near the bottom of the arroyo, near the center line of the claim.

Because of imperfect knowledge of the prospect, its distance from major past production, and the high anticipated cost of underground

exploration, further work on the Wasp prospect might best await success in exploring the more attractive Silver Hill area.

Black Hawk Prospect (Silver Hill)

By far the most impressive result of the geochemical work is the large arsenic anomaly obtained on Silver Hill (see Plates 4 and 5). Exposures in the area are good, and dozens of shallow prospect pits and trenches have superficially explored every showing of mineralization, either vein in place or float. It can be presumed that, if this arsenic anomaly is related to undiscovered ore, such ore must lie at depth or it would certainly have been developed long before now. Such an inferred relationship of broad arsenic halo to "blind" precious metal ore shoot is consistent with previous experience with arsenic as a pathfinder, and is in fact just the sort of relationship which invites use of the method.

In addition to the numerous shallow surface prospects on Silver Hill, a number of more ambitious projects have been undertaken to explore the hill at depth (see Plate 5).

Silver Hill adit.--One of the older prospects is the Silver Hill adit, a heading into the northwest side of the hill, from the Silver Hill mining claim, at an elevation of about 8100 ft. This adit is only about 200 ft. long, far too short to have penetrated the area of interest. It is too low down on the hill to be considered in exploration work.

Monarch adit.--The Monarch adit (8075 ft. elevation) is driven into Silver Hill from the northwest edge of the area of interest, and apparently encountered mineralization on the Seminole vein, for a raise through to the surface was driven. Apparently stoping was done from the raise. The Monarch adit also explored the Radical vein at depth (over 300 ft. below

surface croppings). The Monarch workings did not intersect the Spotted Tiger vein, as one might presume at a glance of the map, unless the intersection might have been by raising almost vertically from the end of the Monarch workings. This is thought unlikely.

Gladiator adit.--The Gladiator adit was a drift on the vein in the center of the mining claim of the same name, and apparently did not encounter significant amounts of ore.

"Dream" adit.--Little is known of the history or extent of the obviously large working labeled "Dream" adit on Plate 5. According to Mr. F. A. Junquist it was driven by "a Frenchman" during the mid-depression years, his dreams providing direction to the work. Several maps show different positions of the workings, but they agree in that the adit was irregular and terminated approximately directly beneath the end of the Monarch adit. This tunnel will be opened and mapped. It is far too deep to consider in exploration work, but will provide good geologic information. ?

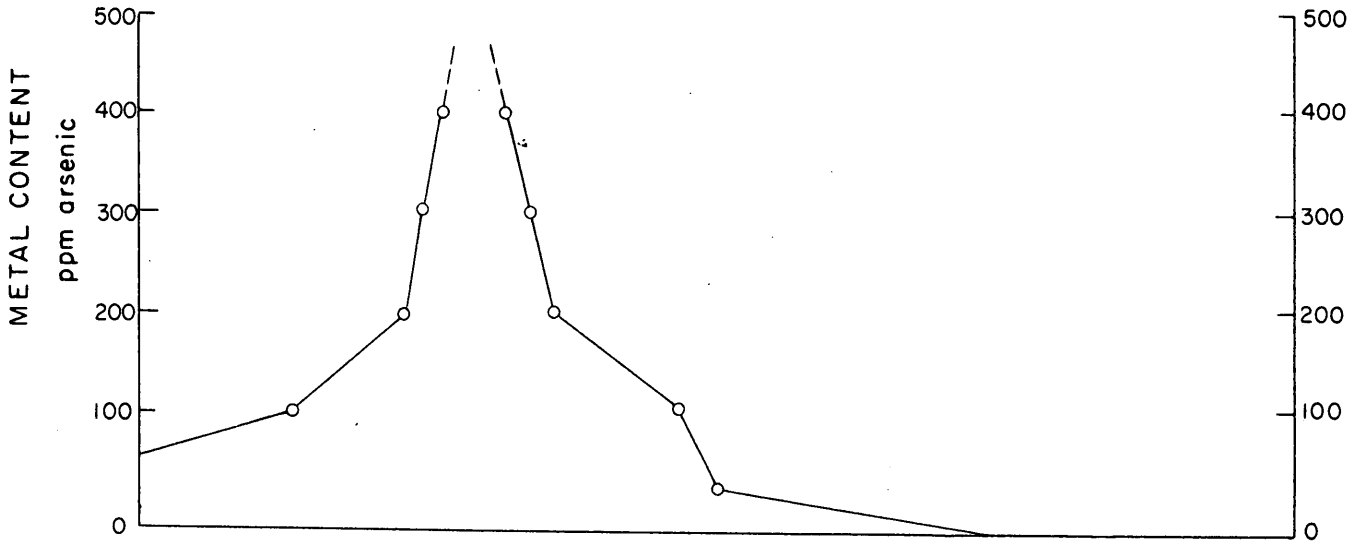
Hornet adit.--The Hornet adit, at elevation 7994 ft., was re-opened by Great Basin Exploration Company during the fall of 1964, as it heads directly toward the area of interest, and there was a chance that additional drifting or raising might not have been indicated on old maps. The adit is shown on Plate 5, and was an obvious attempt to explore the great mass of vein cropping at the intersection of the Black Hawk with the Radical vein. The adit penetrated the Radical vein, but missed the intersection with the Black Hawk, which would have pitched off 250 ft. to the south, on the dip of the vein, at the tunnel level. In any event, this adit is over 300 ft. below the croppings on Silver Hill, below the normal depth to which high grade Aurora

ores extend. This adit would be invaluable for haulage and development purposes if ore should be discovered on Silver Hill.

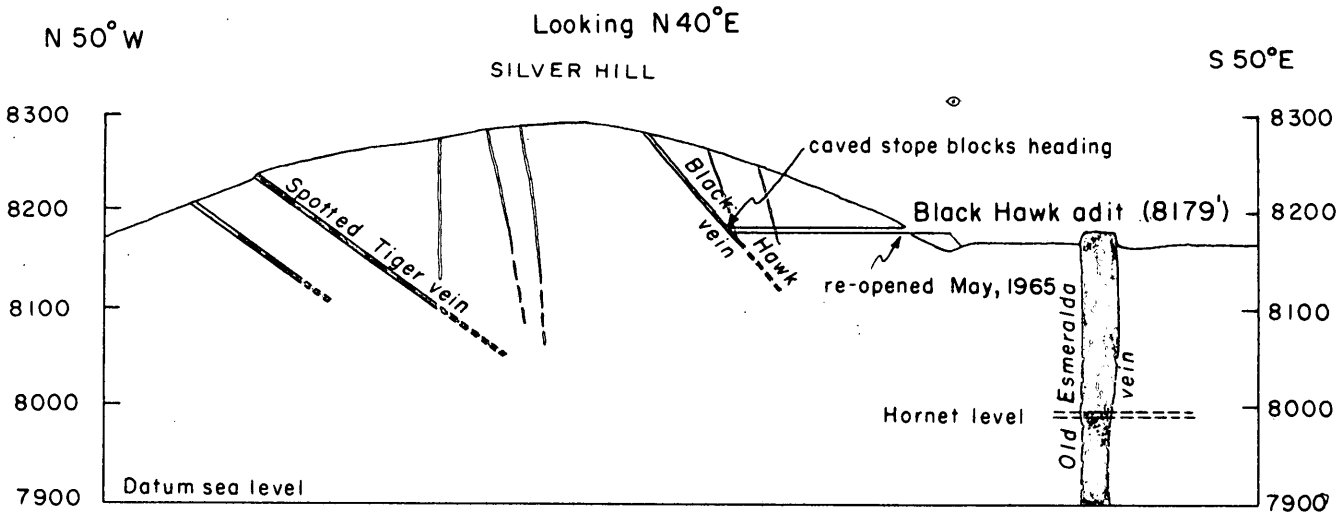
Black Hawk adit.--The Black Hawk adit (8179 ft.) was re-opened by Great Basin Exploration Company in May of 1965. It might possibly have penetrated the area of interest, if late work was not posted on the maps. The tunnel is blocked with waste and fill from an old stope in the hanging wall of the Black Hawk vein (see Figure 5, p. 36). Old timber, square nails, worked rock, etc., in this material blocking the drift all indicate that a very old ore chute has rotted out, letting the waste down onto the level. It was not possible to probe through this material to see if workings penetrate far into the footwall of the vein, but this seems unlikely, for the adit is a very large one, and the size of the dump can be accounted for by the approximate amount of mine opening now visible for inspection. The Black Hawk tunnel is at a near perfect elevation to explore the geochemical anomaly and is headed on exactly the correct bearing, about 75-100 feet shy of the target.

Spotted Tiger mine.--On the north end of Silver Hill, just over the brow at coordinates 12,800 N, 12,200 E (see Plate 5), are the workings of the Spotted Tiger mine. Several inclines, a shaft, and stope through to the surface at one point indicate that a bonanza deposit was mined along the hanging wall of the Spotted Tiger vein where the steep hanging wall split comes up along the side of the road shown on the map. This mine is at the extreme north edge of the geochemical anomaly. The wrokings of the Spotted Tiger mine are limited, to judge from the size of mine dumps. Even if sub-level drifts or inclines had been directed toward the south into the area of the anomaly, they could not have gone far.

In summary, no known underground mine openings penetrate the geochemical



GEOCHEMICAL PROFILE



GEOLOGIC SECTION

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Mineral County Nevada

GREAT BASIN EXPLORATION COMPANY

Geologic Cross Section

BLACK HAWK PROSPECT

AURORA MINING DISTRICT

Scale: 1" = 200'

Anthony L. Payne July, 1965

Figure 5

anomaly and it is particularly unlikely that the zone of maximum interest, from 50 to 150 feet beneath the surface, has been explored. It is interesting to note that the only vertical shaft of any depth sunk from atop Silver Hill, is the 50 ft. deep opening shown at 12,420 N., 11,820 E., which penetrates the low spot between the two pronounced highs which constitute the Silver Hill anomaly.

Evaluation of Black Hawk potential.--The geochemical anomaly at the surface lies in the hanging wall of the Spotted Tiger vein, and in the footwall of the Black Hawk vein, a distance of 400 ft. across the top of Silver Hill. Several interesting vein structures crop out in this interval, all of them more or less parallel to the Black Hawk vein. As can be seen on the geologic cross section, the Spotted Tiger vein has a much more gentle dip (30° - 50°) under Silver Hill than one might judge from outcrop behavior. The flat dip takes this vein under the Black Hawk vein and related structures in such a manner as to suggest that they are hanging wall branches of the Spotted Tiger lode. Such hanging wall splits from prominent, gentle dipping main lodes, are a common locus for bonanza ores.

There is a good chance then, that the geochemical anomaly on Silver Hill is due to bonanza mineralization in steep hanging wall splits from the Spotted Tiger lode under Silver Hill. Erosion has not progressed far enough to quite expose these shallow zones, except for the one over the brow of the hill at the Spotted Tiger mine at the north edge of the anomaly.

EXPLORATION RECOMMENDATIONS

It would be impractical to lay out a complete program for thorough evaluation of the entire Silver Hill anomaly. The area is too large to be

carefully explored at expense commensurate with risk at this time. It is proposed that one clearly defined portion of the area be selected for exploration, the southern part of the anomaly just ahead of the Black Hawk adit face. This area is convenient for any form of exploration work. The geochemical anomaly is concise and is observed to be related to one or more veins cropping out on the hilltop. These veins are of a type that is known to be productive elsewhere in the district. If exploration of the Black Hawk area is successful, the way will be clear to thorough exploration of the remaining ground. Conversely if no ore is found under this portion of the anomaly, there would be scant hope of finding good ore in the northern portion.

The writer feels that the key to successful exploration of the Silver Hill area will be in the careful design and diligent conduct of a thorough test of the validity of the geochemical interpretation. Normally, one might entertain the idea of ranging widely over the claims doing a bit of work here and a bit there in the hope of chancing on to something.

Precious metal ores are notoriously difficult to explore and develop. So much so that many engineers and geologists refuse to consider the use of the exploration drill. The ores are commonly brecciated siliceous zones that contain such minerals as free gold, scattered through pockets and fractures of ocherous limonitic material. The ore zones may be thin seams that easily escape notice, even in the most carefully conducted diamond drilling program.

All of the above factors taken into consideration, the following proposal is presented for exploration of the Black Hawk prospect:

Slusher Crosscuts Underground

The plan on the following page (Figure 6) is a projection of all geologic data to the 8180 ft. elevation, showing the relative position of the veins, geochemical anomaly, Black Hawk adit, and a proposed program of exploration by four slusher crosscuts, each driven 90 to 125 ft. through the target area.

It is believed that such a program of underground openings, although more expensive, would be better than exploration drilling. In this case, the only advantages to drilling, either from the surface or underground, would be faster progress and lower total cost. The disadvantages are summarized as follows:

(1) Unsatisfactory recovery of core and sludge samples from drill holes often occurs in exploring for deposits of this type. The ore zones are commonly brittle and/or friable, and the ore minerals constitute a small, heavy portion of the sample that is easily lost. Assays of drill hole samples may thus be misleading.

(2) Drilling produces a small sample which is often incomplete. Sample recovery is commonly poorest in the zones of greatest interest. Experience demonstrates that important geological and mineralogical clues to the presence of ore may escape recognition in drill holes.

(3) Proper interpretation of drilling results requires constant personal supervision of the operations by an experienced geologist. Such close supervision, from a practical standpoint, is very difficult unless a geologist can be assigned full time to the drilling operation. The added cost cancels some of the cost advantage of drilling over underground work.

(4) Winter weather would severely hinder, if not entirely eliminate a drilling program conducted from the surface of Silver Hill, but would only inconvenience underground work.

(5) If indeterminate results are encountered, as is very often the case in prospecting for silver-gold deposits of this type, little can be done to improve upon the sample from a drill hole. An entirely new hole must be drilled in order to gain additional information. This is of course not the case when taking samples from underground workings.

A program of underground slusher crosscuts would provide a thorough test of the target area, and would make possible visual inspection and collection of large channel samples of all mineral showings. Raising, drifting, or winzing, could be done conveniently in areas where additional information is needed.

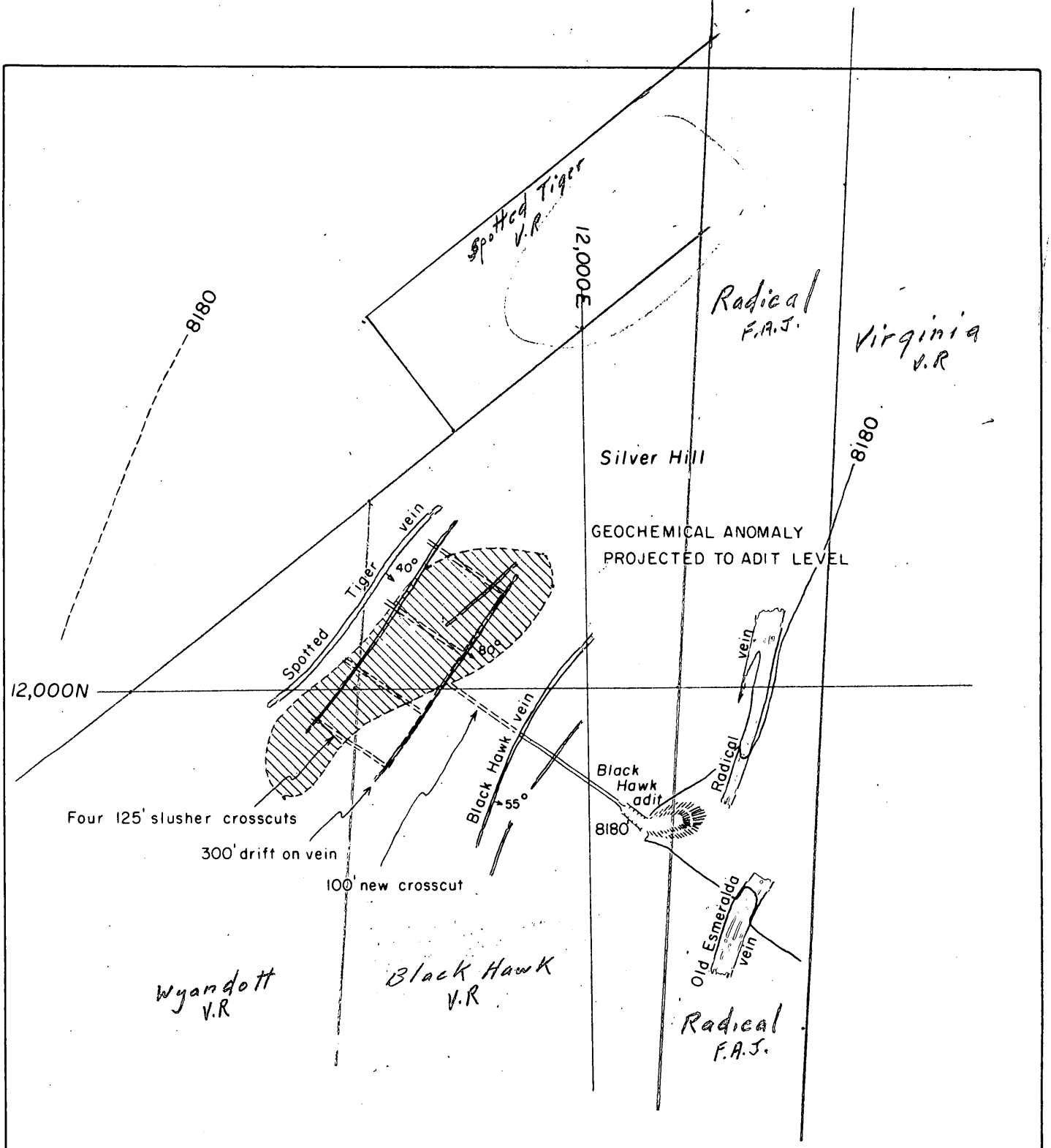
In order to accomplish this program, the Black Hawk Adit should be rehabilitated. Slough at the portal should be cleaned up, and rail, air, and water lines installed to the face. Ventilation duct should be carried to the face. A padlocked door should be placed at the portal. No timbering would be necessary, as the ground is in good condition. The present tunnel is of sufficiently large cross section for tramming of waste from the exploration headings.

At the face, it will be necessary to get through the debris described on page 35, either by spiling or by drawing all of the waste down by mucking and tramming to the dump. The old face should be just behind this pile of debris, a few feet into the footwall of the Black Hawk vein, probably just far enough to have provided tail room for mine cars under the old ore chute that has rotted out.

Once this face has been regained, approximately 150 ft. of new crosscut will be driven on a N. 50° W. bearing (the approximate heading of the existing adit) to the un-named vein that appears to border the southeast side of the geochemical anomaly.

Upon intersecting this vein in the crosscut, drifts will be driven 150 ft. in each direction, to the left and to the right, and four pony sets constructed at 100 ft. intervals along the vein. car loading slides

From each of the four pony sets, slusher crosscuts will be driven at least 90 ft., and as much as 125 ft. if cable capacity of slusher drums



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Mineral County Nevada

GREAT BASIN EXPLORATION COMPANY

Exploration Layout – Slusher Crosscutting

BLACK HAWK PROSPECT

AURORA MINING DISTRICT

Scale: 1" = 200'

Anthony L. Payne July, 1965

Figure 6

will permit, and all other factors are going well. For the purpose of cost estimation, it is assumed that each of these slusher crosscuts will be driven 100 ft. from the center line of the drift under the pony sets. If progress is good, more crosscut can be driven without increasing total cost. In any case, at least 90 ft. will be driven in each slusher heading.

All underground workings will be mapped geologically on a scale of 1 inch equals 20 feet. All mineralized showings will be channel sampled, using a factor of at least 15 lbs. of sample for each foot of channel. The samples will be sent for silver and gold assay to Hawley and Hawley, Assayers and Chemists, Tucson, Arizona.

Primarily on the basis of assay data from the above sampling program, but also upon geological and mineralogical evidence, 100 feet of additional drifts, raises, or winzes will be driven to thoroughly evaluate the best showings of mineralization.

Upon conclusion of the work outlined above, it is anticipated that additional work would be considered only in the event of discovery of an ore deposit of sufficient size and grade to be profitably mined at current silver and gold prices. Such additional work would be more in the nature of development rather than exploration, and in this type of ore deposit, may be expected to pay for itself almost immediately.

If the exploration program outlined above is unsuccessful, no further work is recommended in the Silver Hill area, and the exploration concepts outlined earlier in this report may be considered to have been thoroughly tested.

The cost of exploration by slusher crosscuts it estimated as follows:

Cost of Exploration

Independent Contracts.--

(a) Bulldozer road work.

Repair road from Aurora to Esmeralda Gulch. Improve newly constructed road over Silver Hill. 60 hrs. at $15/hr.	$ 900.00
Transport dozer to and from Carson City	200.00

(b) Underground work.

Rehabilitate Black Hawk adit, install rail, air and water lines, ventilation duct, build door at portal, 150 ft. at $10/ft . . .	1,500.00
Crosscut 150 ft. at $38.50/ft	5,775.00
Drift 300 ft. at $38.50/ft.	11,550.00
Four slusher crosscuts, 400 ft. at $25/ft . . .	10,000.00
One Hundred ft. of small, following raise, drift, or winze, at $30.00/ft	3,000.00

Personal Services.--

(a) Geological supervision, geological mapping, 5 months, 1/4th time, at $800/mo.	1,000.00
(b) Sampler, 6 days at $20/day	120.00
(c) Surveying, 3 days at $75/day	225.00

Operating materials and supplies.--

(a) Sampling supplies and materials	35.00
(b) Engineering and office supplies and materials. . . .	25.00

Operating Equipment.--

(a) Lease of old, small bulldozer or end loader to use in maintaining road wash-outs, remove snow from road, etc., while project is in progress. Leave with underground contractor at mine. Contractor to furnish operator, fuel, repairs, and insurance. 5 months at $150/mo, $100 transportation of machine in and out of Aurora	850.00

Initial Rehabilitation and Repairs.--

None, exclusive of mine workings	--

New Buildings, Fixtures, Installations.--

(a) Construct powder magazine at surface	350.00
(b) Construct tool shed at portal of tunnel	170.00

Miscellaneous.--

(a)	Assaying, including shipment charges	$ 600.00
(b)	Accounting	150.00
(c)	Secretarial work, typing	50.00
	TOTAL FOR PROJECT	$36,500.00

It is estimated that the project will required 5 months to complete if the contractor works on a two shift per day basis. The total time is calculated on a basis of a 5 ft. round per shift in standard crosscut and drift headings, and two 4 ft. rounds per shift in slusher headings.

Approximately 2 weeks will be required to set up camp, construct powder magazine and tool shed, rehabilitate portal, regain working face, etc. About 11 weeks will be spent driving the 150 ft. crosscut, and drifting 300 ft. on the vein. An additional 5 weeks will be required to construct the pony sets and drive the four 100 ft. slusher crosscuts. After the slusher crosscuts are in, an additional 2 weeks would be spent in drifting, raising, or winzing on the best showings of mineral.

Surveying, geologic mapping, and channel sampling would be done currently as the work progressed.

A report summarizing the results of the exploration program would be written at the conclusion of the project.

Respectfully submitted,

Anthony L. Payne

Anthony L. Payne
Mining Geologist

August 31, 1965

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