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PREFACE

This bulletin on the "Mineral Resources of Nye County" is the third to be issued by the Nevada State Bureau of Mines, it being preceded by the "Mineral Resources of Douglas, Ormsby, and Washoe Counties," and the "Mineral Resources of Storey and Lyon Counties."

The Bureau has been fortunate in obtaining the services of Victor E. Kral, a Mackay School of Mines graduate of 1938, as the mining engineer to prepare this bulletin.

From 1939 to 1942, he was the instructor of the traveling school for prospectors of the Nevada Department of Vocational Education. From 1942 to 1944, he was with the War Department examining mining properties in the Tonopah Bombing Range, and to 1946 with the U. S. Bureau of Mines as a field engineer along with the preparation of six "Reports of Investigations" on Nevada mines.

His thoroughness, his willingness to give information and aid to all, and his pleasing personality are all hereby gratefully acknowledged.

The first summary of all the State's mineral resources to be published was the "Mining Districts and Mineral Resources of Nevada" by Francis Church Lincoln in 1923. This was prepared by him while Director of the Mackay School of Mines of the University of Nevada and before the Nevada State Bureau of Mines came into existence in 1929. The Bureau has since distributed this authoritative 300-page book to a very appreciative public. Naturally, the treatment of each mining district was restricted to a short statement, but accompanied by an excellent bibliography.

In the '30's the United States Bureau of Mines started a study of the State as to the mining activities in each county. This work was carried out by William O. Vanderburg, and before this work was discontinued, by war necessity, there had been issued as information circulars, the "Reconnaissance of Mining Districts in Churchill County," I. C. 7093; "in Clark County," I. C. 6964; "in Eureka County," I. C. 7022; "in Humboldt County," I. C. 6995; "in Lander County," I. C. 7043; "in Mineral County," I. C. 6941; and "in Pershing County," I. C. 6902, or seven in all. While these reports covered only the active mines in those counties at that time, they have proved to be of great value to our Bureau and to

after localities is the ease of finding the same on maps or in the field.

The geological descriptions in this bulletin are based, in great part, upon publications and maps of the United States Geological Survey, too numerous to mention individually.

The two best general references are the Bureau's two publications, *Mining Districts and Mineral Resources of Nevada*, by Francis Church Lincoln, and *Bibliography of Geologic Literature of Nevada*, by Vincent P. Gianella, with the *Bibliography of Geologic Maps of Nevada Areas*, by Robert W. Prince.

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Director, Nevada State Bureau of Mines.

ACKNOWLEDGEMENTS AND REFERENCES

My acknowledgements and thanks go to the large number who have in one way or another aided in the gathering of information and the writing of this bulletin. In the field work, the property owners and prospectors themselves have aided the most. Much information was obtained from reports and notes in the files of engineers and other interested parties; this, whenever possible, was tied in with information obtained in the field.

Director Carpenter, with his years of experience in Nevada during which he visited, examined, and operated mines in many Nye County mining districts, aided greatly by supplementing and checking information obtained from other sources. Mr. Carpenter also did all the critical reading, which the writer believes was exceptionally well done.

The staff of the Mackay School of Mines have all aided in the preparation of this bulletin. The geology department in particular was often called upon, and special mention is due Director Walter S. Palmer and his assistant, Claude W. Hammond of the State Analytical Laboratory for analytical and mineral determinative work done.

Most writers and their publications which were used are mentioned in the text or in footnotes; however, a few publications are used so frequently that the writer's name alone is mentioned. These are as follows:

Couch, Bertrand F., *Nevada's Metal and Mineral Production: Nevada State Bureau of Mines, Vol. XXXVII, No. 4, 1943.* (This is supplemented by later unpublished figures from Mr. Couch.)

Lincoln, F. C., *Mining Districts and Mineral Resources of Nevada; Nevada Newsletter Publishing Company, 1923.*

Bailey, E. H. and Phoenix, David A., *Quicksilver Deposits in Nevada: Nevada Bureau of Mines, Vol. XXXVIII, No. 5, 1944.*

Ball, Sydney H., *A Geologic Reconnaissance in Southwestern Nevada and Eastern California: U. S. Geological Survey Bull. 308, 1907.*

Raymond, R. W., *Statistics of Mines and Mining in States and Territories West of the Rocky Mountains: (Year of publication given in reference.): U. S. Government Printing Office, Washington, D. C.*

Thompson and West, publishers of *History of Nevada, 1881.*

The period of the rushes and the booms is probably gone but production developed from the careful use of all modern exploration techniques has yet to get a good start. Today we have faster, and possibly better, methods of geologic mapping; aided by aerial photography (including color), better roads, and more versatile means of transportation. We are just beginning to make use of geophysical surveys integrated with other geologic mapping.

For the actual physical exploration, machinery today has been designed to give better and faster results with less weight and less cost of operation. Diamond drills are lighter and more mobile; bits are precast, allowing the use of cheaper stones and making the over-all cost lower. Small rotary drilling rigs are coming into the same fields occupied by diamond drills and churn drills. Roads are better and there are more of them, also, small road building tractors make it possible to take exploration equipment to places formerly considered inaccessible. Compressors are mounted on rubber-tired wheels for greater mobility and in some cases are made as an integral part of small tractors to aid in the building of roads.

Exploration equipment is now so readily moved that many formerly productive mines can have additional exploration more easily done. Favorable unexplored sections of the vein or the walls may be quickly probed for new ore bodies. Many mines filled with water only have a low or moderate water flow that, with modern portable electrical generating equipment and electric pumps, can be unwatered with speed and efficiency.

Geophysical exploration, coupled with geologic mapping of many of our "worked out" sulfide ore deposits, can give us a tremendous amount of information at relatively low cost. Favorable areas may then be physically explored.

These advances in exploration techniques which help mining are in use today, but not generally so. When we finally make use of all our facilities to find new ore deposits, the production of Nye County as well as many other areas will increase rapidly.

It appears that the underlying necessities to any future exploration program are good geologic maps of the mining districts. To date only a small fraction have been mapped and the sooner this work is completed the sooner we may expect the next steps in the search for our hidden mineral wealth to gain momentum.

Changes in mining and metallurgical techniques will in the future, as they have in the past, make many marginal mineral deposits worthwhile to mine. The increased efficiency of surface mining methods, with their low cost, have already resulted in

many new mining operations in the State. Also, in the field of nonmetallies, deposits of now worthless material are very apt to become marketable as time goes on.

The excitement of oil exploration has recently struck Nevada and has caused considerable lease speculation. Although only a minor area has been leased in Nye County, the heaviest leasing being in the counties to the north and east and in the southern part of the State, exploratory drilling is now being conducted in White Pine County only 9 miles from its boundary with Nye County. As of October 1950, about 2 million acres of Government land in Nevada had been leased for oil and gas. Although this interest in the search for oil in Nevada is a great help to the State, needless to say, the finding of oil would be a tremendous benefit to all of the State as well as to the individual counties involved.

MINING DISTRICTS

ANTELOPE SPRINGS

The Antelope Springs mining district lies on the east slope of the Cactus Range near the southeastern end of the main part of the range. It is about 30 miles southeast of Goldfield and is all within the Tonopah Bombing and Gunnery Range.

Antelope Springs, for which the district was named, furnish sufficient water for camp purposes and it is believed that enough water for milling could be obtained by drilling wells.

The district is well described by F. C. Schrader.⁵ He states that gold was discovered here in 1903 by the Bailey brothers of Cactus Springs. In November 1911, Jordan and Reilly discovered high-grade gold ore and soon about 150 men were prospecting the immediate area. Schrader states:

By the close of the year a \$15,000 five-day option had been taken on the Antelope View claim (Jordan & Reilly) by George Wingfield of the Goldfield Consolidated Mines Company, who prosecuted the work of sinking a shaft continuously with good results, but as he wished a brief extension of time, which it is said the owners would grant only at a very large price, he relinquished the option.

As a side light, this story has a moral. Many a prospector has died in poverty because he failed to realize that the consummation of a reasonable agreement can mean a profit for both parties,

⁵Schrader, F. C., Notes on the Antelope District, Nevada: U. S. Geol. Bull. 530, Part 1, pp. 87-98, 1911 (1912).

1870 by one of several Mexican Prospecting parties outfitted by Emanuel San Pedro. This man did much work in the early days of Grantsville and Ellsworth in the northwestern part of the county and may have been responsible for the early work in the San Antone district.

Couch shows a total recorded Barcelona production of \$198,952 from 7,854 tons, of which amount \$165,456 from 4,843 tons was produced during 1875-1889. The balance was mined by the Consolidated Spanish Belt Silver Mining Company during 1920-1922. This company installed a 50-ton flotation mill in 1921 which operated about a year.

The presence of molybdenite in the area has added interest to the mine in recent years and some work was done on these exposures in 1942-1943 by J. C. Perkins of Tonopah. Trenching of a disseminated occurrence in hornfels near an alaskite intrusive found the material to contain 0.39 to 3.0 percent molybdenum.

The principal working is a long adit reported to be 2,000 feet or more in length. Molybdenite is also said to occur in this adit.

The Van Ness mercury mine, believed owned by John Connolly of Tonopah, is well described by Bailey and Phoenix. The property lies at an elevation of 8,600 feet, about 6 miles northwest of the town of Belmont. Since its discovery by Jack Humphrey in 1928 it has produced 728 flasks of mercury. Most of the production was made by Raymond Van Ness in a 30-ton Cottrell furnace in 1930-1931. Since 1931, during the period of high mercury prices, lessees produced 25 flasks annually from retorts. The rotary furnace is believed to be on the property. The principal workings are two glory holes tapped with a haulage adit, and a 135-foot inclined shaft with stopes. A 900-foot adit driven to explore the ore at depth has produced little.

The War Eagle group, owned by W. A. Flower of Tonopah, lies 1½ miles above Flower's camp in Antone Canyon which is 12 miles by road north of the town of Belmont. Gold and silver values associated with lead and copper minerals are reported found here in metamorphosed shale and limestone. The workings consist of a 500-foot crosscut adit, a 75-foot adit and several shallow shafts. The longer adit is said to require another 200 feet to reach the vein.

The Fiorite group of mercury claims, owned by W. A. Flower and W. F. Logan, is situated near Flower's camp in Antone Canyon. Bailey and Phoenix describe the property and report that about 50 flasks of mercury have been produced since its discovery

by Mrs. Flower in 1908. Small quantities of good-grade ore have been sorted from the workings in a 30-foot rib of silicified sediments. The property is equipped with a two-pipe, oil-fired retort.

Several groups of placer claims have been located in both Meadow Canyon and its branch Antone Canyon. Nine holes sunk 1 to 20 feet to bedrock are said to have panned about \$0.30 in gold per cubic yard on bedrock.

The Titanium placer group, located by W. A. Flowers, lies near the junction of Antone Canyon and Meadow Canyon. A concentrate of the material from here is said to have contained 12.3 percent titanium oxide.

The Senator mercury mine, described by Bailey and Phoenix, is owned by George J. Barry of Los Angeles and lies at the head of the north fork of Mariposa Canyon on the west slope of the Toquima Range. It is reached by 3 miles of pack trail from the end of the Shoshone Canyon road east of Round Mountain. About 100 flasks of mercury have been produced from here since the discovery of the property in about 1925. The mercury is said to occur as cinnabar and metacinnabar in veins in granite. The workings consist of several adits, the longest of which is 90 feet.

The Monarch camp, of unknown ownership, lies about 15 miles by road south of Belmont. The claims appear to have been located for copper and turquoise, as some poor-grade gem material is found in a deep trench. In the area, apparently once located for copper, a ferruginous chert and jasper shows some faint copper stains. Two buildings here in liveable condition appear to have been used in the last 10 years.

Old wolframite workings are found about 5 miles southwest of the town of Belmont. The tungsten mineral is found in quartz veins that show considerable shearing. The workings are minor, consisting of shallow shafts and cuts.

The "pebble quarry," identified by several dumps on the north side of the Belmont-Manhattan road, lies about midway between the two towns. H. G. Ferguson¹⁷ describes this old property.

A deposit of silicified tuff occurs on the east side of the Toquima Range, close to the Belmont Road, about 8 miles from Manhattan. This rock is quarried and after rough grinding in a tube mill shipped to Manhattan, Tonopah, and Goldfield for use in tube mills. The quarry is known

¹⁷Ferguson, H. G., *Geology and Ore Deposits of the Manhattan District, Nevada*: U. S. Geol. Survey Bull. 723, p. 79, 1924.

has been stoped to the surface. The mine is opened by two connected adits totaling about 400 feet in addition to several minor workings. Improvements consist of a 50-ton ore bin and several buildings in good condition.

The Derelict mine, a gold property consisting of two claims, is west of and adjoins the Ole Peterson. It was originally part of the Penelas estate, however, in recent years has been relocated by Mory Stromer of Broken Hills. Although the mine has no recorded production, it is reported that shipments were made in 1939. The workings include a steeply inclined 300-foot shaft. Gold ore is said to occur here in a recemented brecciated rhyolite.

BULLFROG (Beatty, Pioneer, Rhyolite)

The Bullfrog mining district includes the vicinity of Beatty west of the Las Vegas highway and the region near the old towns of Rhyolite and Pioneer. It adjoins the Fluorine district on the west. Topographically the Bullfrog district covers all of the Bullfrog Hills and also includes properties in the adjoining part of the Grapevine Mountains. Beatty is on the Tonopah-Las Vegas highway, 93 miles from Tonopah and 114 miles from Las Vegas.

As stated by Mrs. Byrd F. W. Sawyer, of Fallon, in her "Gold and Silver Rushes of Nevada 1900-1910,"¹⁸ the Bullfrog district was discovered on August 8, 1904 by Shorty Harris and Ed Cross. The discovery was made at what is now usually referred to as the Original Bullfrog mine about 4 miles west of the town of Rhyolite. The name is said to have been suggested by the green color of the gold ore associated with copper in a bold quartz outcrop. Such choice of name on an August day in this arid section is subtle to say the least.

Ransome, Emmons, and Garrey in U. S. Geological Survey Bulletin 407 on this district mention that long before the discoveries of Tonopah and Goldfield, settlers had established ranches at the springs of Oasis Valley just north of the present site of Beatty. The roving prospectors of that day occasionally prospected the hills in this area but the rich discoveries to the north gave impetus to the prospecting which resulted in the Bullfrog discovery. In a very short time the area between the Bullfrog group and the Amargosa River was covered with claims.

The first railroad to come into the area was the Las Vegas and Tonopah which reached Beatty on October 22, 1906. Two months later it was extended to Rhyolite which by this time was the principal town in the district. Competition for the Bullfrog district

¹⁸University of Calif. doctorate thesis, 1931.

freight was keen as the area finally had three railroads. The Tonopah and Tidewater came up across the desert from California and the Bullfrog and Goldfield came down from Goldfield. This gave the new camp transportation facilities comparable or superior to older and better established districts. These facilities were absolutely necessary as the quantity of high grade that could stand a high wagon-freight cost was small in the Bullfrog district. Figures taken from Ransome show about 113 tons shipped by the end of 1905 with small unrecorded shipments in 1906. However, in 1907 the production was about 9,000 tons valued at \$264,964.

Transmitted electric power is another important facility obtained by the mines in the Bullfrog district. The Nevada-California Electric Power Company, which had previously brought its lines into Tonopah and Goldfield, extended its distribution system to include the Bullfrog area. This was important to the Montgomery-Shoshone and the Tramps mines as each installed mills. The mines and mills of the Pioneer area in the northern part of the district also benefitted from this source of power.

Couch shows the total recorded production of the Bullfrog district to the end of 1948 to be \$1,885,778; however, the four grand years were 1907-1910 during which \$1,687,792 was recovered from 158,594 tons, or an average of \$10.65 per ton. Of this amount the Montgomery-Shoshone in this period produced \$1,344,105 from 128,980 tons or \$10.42 per ton. These figures show that Bullfrog ore was generally low grade.

Ransome states:¹⁹

From this summary it appears that the Bullfrog district contains only one mine (Montgomery-Shoshone) of moderate size and of steady productiveness. The others are small and up to the middle of 1908 no one of them could be said to have emerged from the prospecting and experimental stage. Whatever the expectations excited from time to time by the finding of superficial bunches of rich ore, there can be no doubt that the veins as a whole are to be classed as low grade when the conditions under which they must be exploited are taken into consideration. They are in no way comparable with the remarkable bonanzas that have brought fame to Goldfield and can not be successfully worked by the same methods.

¹⁹U. S. Geol. Survey Bull. 407, p. 92.

Development is by several thousand feet of workings. The main shaft is 550 feet deep and the last work is said to have been done on the 115-foot level. Equipment on the property is in good condition and in readiness for immediate operation. Water is hauled from Beatty.

The Happy Hooligan mine, now known as the Patootse and owned by Charles E. and F. C. Phinney of Beatty, lies about 16 miles west of Beatty at the eastern base of the Grapevine mountains. Only minor production has been made from the property. Ball states that gold ore is found on the contact of an exposed section of limestone with the overlying basalt. The basalt is in turn overlain by a rhyolite. The exposed limestone here is unusual as the area has a general volcanic cover. He states that much alteration has occurred on the limestone-basalt contact and that free gold can be panned from the alteration products. The contact is traceable for several hundred feet and it is reported that gold values are found in all openings along the contact. About 1,000 feet of work, including a 300-foot shaft and two adits of 200- and 300-foot length, has been done on the property. The owners report that assays taken in the early days ran from \$4 to \$44 in gold and silver. The ore usually occurs in flat bodies 4 inches to 4 feet wide.

The July 4th and Happy Camp claims of the same ownership as above, and about 6 miles northwest, are situated at a spring about 2 miles northwest of Wahguyhe Peak. The group was located in 1930 and 50 tons of \$17 gold and silver ore is reported to have been milled at Pioneer. The ore is free milling and occurs in shear zones and veins up to a 33-foot width in rhyolite. Samples across wide widths are reported to assay \$4 to \$12 per ton. About 900 feet of work has been done here in two adits.

The Niterville group, owned by Dr. W. R. Colbert of Elsinore, California, joins the July 4th group. The owner reports a wide width of \$15 ore in rhyolite. Workings consist of a 200-foot adit, a 100-foot shaft, and several open cuts. The property has no known production.

The Homestake mine situated 6 miles northwest of Rhyolite is owned by Charles A. Liddell of Los Angeles. A 500-foot 63° inclined shaft was sunk here in the early years of the district and a well-built, 25-stamp mill erected in 1908. A news item of January 1909 mentions treating 75 tons of \$7 ore per day. The mill operated less than a year when it was shut down for lack of ore. Couch shows a recorded production in 1908-1909 of \$54,261 from 9,803 tons. It is reported that in 1940 considerable \$35 ore found

in the footwall of the vein was shipped to the State Line mill in Esmeralda County. Some \$20 ore is said to be left in the mine; however, there is now no profitable way to handle ore of this grade in the district. The Homestake vein occurs in rhyolite and strikes northerly. It is said that the more quartzose ore of the vein, which was mined in the early days, is not the best. The better-grade footwall ore, shipped in 1940, is a highly altered rhyolite containing much calcite but little quartz. The headframe and shaft appear to be in good condition; however, the shaft is said to have no timber below the 300 level. No other improvements are on the property. The massive mill foundations are a prominent landmark and identify the mine.

The Gold Bar mine, reportedly owned by Mike Chulick of Winters, California, adjoins and is south of the Homestake. This property is similar to the Homestake and apparently is on the same vein. The principal work was done prior to 1908; news items of 1907 mention a 500-foot shaft with 4,861 feet total workings. A 10-stamp mill was installed but its life was short as work was suspended in May 1908. Ransome states, "The Gold Bar lode is a zone of irregularly fissured and brecciated rhyolite fully 100 feet wide. The hanging wall is generally a fairly regular and persistent slip along which some displacement has occurred since the vein was formed. On the footwall side there is no definite boundary between vein matter and more or less disturbed rhyolite. The general strike of the lode near the shaft varies from N. 55° E. to N. 65° E. and the average dip is about 65° NW." The shaft is now open to the 250-foot level with about 1,000 feet of workings on the 150, and 400 feet on the 250; this being about the same work mentioned by Ransome in 1908.

The Mayflower is in what is commonly referred to as the Pioneer district which is here included in the Bullfrog. The area is 10 miles by road northwest of Beatty and is reached by traveling 6.3 miles north of Beatty on the highway and then west. The mine is owned by the Consolidated Mayflower Mining Company of which Mrs. Mary E. Tobin of Goldfield is president. Her husband, W. J. Tobin, operated the mine prior to his death in 1935. W. H. Emmons of the U. S. Geological Survey visited the property in 1906 at which time the inclined shaft was 100 feet deep. Later the shaft was put down to 530 feet and, as per the Mines Handbook (1922), the property had 3,500 feet of workings. It was then reported to have been thoroughly sampled and to have had an estimated 80,000 tons of \$10 ore. John Devore of Reno worked at the Mayflower in 1918-1919 during which time a drift on the

western part of the range and is the host for the silver occurrences at Orizaba and Republic 2 miles north. Triassic chert of the Excelsior formation, which underlies the limestone, is found about 5 miles south of the Orizaba. The chert is host for an important occurrence of turquoise.

At East Golden, about 8 miles north of the Cloverdale Ranch, gold is found in brecciated rhyolite. Gold, apparently derived from this deposit, has formed the placer on Cloverdale Creek below East Golden. Hillside placers are also found in the area.

West Golden is just west over the ridge from East Golden. Here, gold occurs in narrow veins and placer deposits similarly to those to the east.

Properties. The Republic area is in the extreme northwestern part of the district. Two properties have been worked in this area. One owned by Tom Hyland and others, of Tonopah, has a 200-foot shaft in rhyolite. Several laterals have been driven but very little stoping has been done. The vein is 1-2 feet wide and has some good-grade silver ore. Two samples of the better appearing ore contained 8 and 22 ounces silver per ton.

William Farris of Tonopah has a silver-lead property about one-half mile west of the Hyland ground. Argentiferous galena occurs here in a narrow vein dipping 40° S. with the hillside. A cross-cut adit gives access to the vein which has been stoped to the surface. A raise driven to the surface from the vein was used in the last work in 1949 during which, 12 tons of ore containing 40 ounces silver per ton were shipped by Dunsdon and Cornell.

Republic has several buildings in fair or better condition and a shallow well furnishes domestic water.

The Orizaba or Green Metals mine lies about 1 mile air line south of Republic and 2 miles west of the power line to Gabbs. The property is owned principally by the estate of Lou Miller, with C. C. Boak and John Connolly, of Tonopah, as co-administrators of the estate. Mr. Boak states that the total production to date is \$127,980 from 3,127 tons, or a value of \$41 per ton.

A report²⁹ made by John Dynan, presumed to have been written in the early twenties, states:

Mr. P. V. Rovnianek (operator of the mine) informs me that before he took over the mine there had been shipped to smelters 500 tons assaying about \$100.00 per ton. Since that time there has been shipped (1913-1918) 527 tons of \$22,980.00 gross value, or \$43.22 per ton. These figures are from smelter returns, duplicates

²⁹Copy in possession of C. C. Boak.

of which are in my possession. The average price received for silver in all the ores shipped has been about \$0.70 per ounce.

Dynan reports that the vein occurs in limestone near a granite contact. The strike is northwesterly and the dip is 60° to 80° SW. The inclined shaft is 145 feet deep with levels at 65 feet and 83 feet. Dynan adds that after his examination, letters from Rovnianek state that from a point 110 feet west of the shaft on the 83-foot level, a 65-foot winze was sunk on the vein. Drifts were run 25 feet westerly and 15 feet easterly with the vein quartz said to assay about 40 ounces silver per ton. These letters also stated that the bottom of the shaft was in the footwall and cuttings from long-hole drilling to the vein assayed 12 ounces silver per ton. With the water level just above the 83-foot level, pumping 75 gallons of water per minute with steam driven pumps was very costly and unreliable. Boak states that all ore exposed by the development work, above the water level, has been stoped.

Although most of the Orizaba ore has been oxidized, Dynan states that several bunches of sulfide minerals containing argentite, galena, and sphalarite were found on the 83-foot level. The zinc content of the ore could normally be expected to increase appreciably below the water table.

Director Jay A. Carpenter inspected this property in November 1945. Water stood on the 83-foot level. A picked sample of sulfide ore taken at the collar of the winze assayed 0.06 ounces gold and 50.5 ounces silver per ton. A 6-foot cut sample from a pillar of oxidized ore on the 65-foot level assayed 0.03 ounces gold and 37.4 ounces silver per ton. Professor Smyth's cyanide test on this oxidized ore at minus 80 mesh gave a 95.7 percent extraction.

The Orizaba was last worked in 1949 by Hubert Welch who shipped 44 tons of ore containing 11 ounces silver per ton. The hoist house, with single-cylinder gasoline hoist, and an old boiler house are still on the property and in fair condition. A spring and two good houses are about one-half mile from the mine.

The Blue Gem turquoise mine is south of the Orizaba and 3 miles west of a point on the California Electric Company power line, 5 miles south of the branch road to the Orizaba mine. The mine is owned by Bert King of Gallup, New Mexico. Louis Cirac of Tonopah discovered the property in 1914 and sold it to Lee Hand who mined turquoise for several years. Other turquoise miners have also owned the ground and it may be assumed that considerable gem material has been mined here. The workings

transported to mill down a steep slope by a gravity tram, now partly removed. The camp near the mill consists of about 12 buildings in various stages of disrepair. Water is piped from a spring just above the camp.

The Oro Cache Mining and Milling Company property, controlled by Mrs. Harriet Stingley of Tonopah, is 5 miles westerly of the Eden Creek ranch, at an approximate elevation of 8,000 feet. The claims are west of the South Gold mill. The company was organized in 1929 and explored the ground until 1934, when the closing of the banks curtailed financing. No production has been made from the property. The gold mineralization, which is reported to be entirely free milling, occurs in veins and shear zones in rhyolite. A list of assays, reportedly representing samples taken during exploration, vary from \$2 to \$250 with a large percentage grouped between \$10 and \$70. The workings consist of a 50-foot shaft with 72 feet of drifting from two levels, a 218-foot adit cutting and drifting on the same vein about 50 feet below the shaft, and several shallow shafts and trenches. Improvements are a one-room house built near a spring and a cellar. Although the values occur rather sporadically, the assays available indicate that the property is worthy of further investigation.

The Golden Crown group, also known as the old Eden mine, is owned by the G. B. Fallini estate and lies 2 miles west of the Eden Creek ranch on the road to the Oro Cache and South Gold properties. It is reported that silver ore was discovered here in 1906 and that much work was done during 1923-1924. The principal workings are said to consist of two adits, the upper is 500 feet in length and the lower 1,700 feet long. Both adits are said to have track. Rock found on the upper dump showed quartz seams containing pyrite. The country rock is largely rhyolite intruded by porphyritic andesite. It appears that very little has been done here since 1924 although the ground was leased in 1935.

ELLENDALE

The Ellendale district is 31 miles east of Tonopah and 2 miles south of the Tonopah-Ely highway. It lies at an approximate altitude of 6,000 feet, in the hills of the southern end of the Monitor Range overlooking the Ralston Valley to the southwest. The nearest water is obtained from wells in Salisbury Wash, near the highway, about 2 miles north of the district.

High-grade float was discovered here by Ellen (Clifford) Nay on April 1, 1909. The property was worked by the Clifford brothers and Joe Nay, and by 1915 had produced much fabulous

high-grade gold ore. The production, estimated by Mrs. Mary Dahlstrom of Tonopah and Joe Clifford of Stone Cabin, was one million, and one-half million dollars, respectively. Couch shows a total recorded production from the district, to and including 1948, of \$166,015 from 18,245 tons. Of this amount, \$70,050 from 5,533 tons came from the Ellendale mine.

Henry G. Ferguson³⁴ describes the strike:

The deserted district of Ellendale lies on the road between Tonopah and Stone Cabin, a few miles east of Tonopah. The claims were located a few years ago, and the rich surface showings started a rush which was a miniature repetition of those following the discovery of such camps as Tonopah, Goldfield, and Manhattan. A town was laid out and houses were built, but today a single empty house marks the site of the town. The extent of the older workings is considerable, but apparently only a very small amount of ore was of sufficiently high grade to be shipped. In 1910 there was shipped from the district 25 tons of ore containing \$18,349 in gold and 718 ounces of silver valued in all at \$18,737, or \$720.65 a ton.³⁵ In 1911, 94 tons was shipped, carrying \$54,702 in gold and 1,823 ounces of silver, with a total value of \$55,668, or \$592.21 a ton.³⁶

It may be assumed that neither Ferguson's figures for the 2 years nor Couch's recorded state figures show the total production made. Lessee production is frequently not shown. Joe Clifford of Stone Cabin states that he had a lease on the property in the early days and was able to start in the ranching business on what he made from his lease. This and possibly other unrecorded lease production could account for a large part of the estimated production.

Geology. Ferguson describes this fully:

Most of the workings are in rhyolite, near the contact of andesite porphyry. The rhyolite is fine grained and rather siliceous and carries small phenocrysts of quartz and feldspar. Biotite in rare and minute plates is the only ferromagnesian mineral present. The andesite is similar to that of Clifford and Golden Arrow, but the relations of the two rocks could not be determined.

³⁴Ferguson, H. G., The Golden Arrow, Clifford, and Ellendale Districts, Nevada: U. S. Geol. Survey Bull. 640-F, pp. 122-123, 1916.

³⁵U. S. Geol. Survey Mineral Resources, 1910, pt. 1, p. 525, 1911.

³⁶Idem, 1911, pt. 1, p. 689, 1912.

Geology. The rocks in the main part of the Fairplay district are Tertiary latite and andesite which have been intruded by rhyolitic dikes. The mineralized zones are usually in near proximity to these intrusions. The economic metals here are gold and silver with some lead occurring in quartz veins and shear zones. At the Butler, which probably has had the only appreciable gold and silver production in the district, the ore occurs in quartz veins. In the Paradise Peak area the rocks are Mesozoic sediments that have been intruded by a granitic rock, probably quartz monzonite. Cinnabar associated with scheelite at the Scheebar mine is the principal ore occurrence although some copper and lead prospects have been reported on the west side of Paradise Peak and may be the source of a small production in these metals reported from the district.

Properties. The old Butler mine is situated on the top of a north-south ridge in the eastern part of the district. It may be identified by an old four-post type headframe and its 45° inclined shaft, both of which are in rather poor condition. It is said that this property has had the principal gold and silver production in the district; however, none is on record. The values here are reported to be found in vein quartz 2–10 feet wide on either side of a rhyolite dike 20–100 feet wide. The shaft is 280 feet in depth with 150-, 225-, and 280-foot levels. It is reported that sporadic gold and silver values may be found on the 150-foot level.

What is commonly referred to as the Okey Davis mine, now owned by Gene Perry of Mina, is 2.8 miles north of Goldyke on the same ridge as the Butler mine about one-half mile south. The Davis camp is down the east side of the ridge, one-quarter mile from the mine. This property was operated by the Oatman United Gold Mining Company in the late twenties, which company did much exploration and built a camp containing about eight buildings. The buildings still stand but are in poor condition due to lack of repair. The property has a vertical shaft which The Mines Handbook (1931) states goes to a 300-foot depth and has opened mill ore on the 50-, 100-, and 200-foot levels. The rock here is andesite intruded by a large rhyolite dike which appears to be the same dike found at the Butler mine and may also be the one found at the Jim at Goldyke. The property has had no known production. The headframe and shaft are in good condition, but other improvements were stripped in recent years. From evidence of pumping equipment, some water was encountered in the shaft.

The Jim group owned by Tom Burns of Goldyke is situated in

the southern part of the district adjacent to the site of the town of Goldyke. Apparently no production has been made; however, much work has been done on the claims. Exploration consists of a 140-foot shaft, several shallow shafts, and many surface cuts and pits. The rock here is andesite which has been intruded by a fine-grained rhyolite dike. Most of the prospecting has been done between this dike and a parallel shear zone about 200 feet southwest that bears S. 25° E. and dips 60° SW. Some galena is found, occurring sporadically in quartz veins in the andesite which has undergone intense hydrothermal alteration in much of this area. All the shallow workings are open and accessible; however, the collar of the 140-foot shaft is caved. One building at the old camp of Goldyke is in fair condition, and the remains of an old 5-stamp amalgamation and gravity concentration mill stand just below the camp. The best spring in the district is here; however, it flows only enough water to intermittently operate a small mill.

A gold and silver prospect along the road to Mina, about one-half mile west of Goldyke, has old workings said to consist of a caved shaft and several large open cuts. These claims also belong to Tom Burns of Goldyke.

A property owned by Walter Pfeffercorn, and others, of Mina is situated in the western part of the district, 2.7 miles northwest of Goldyke. Water for camp and mine use is hauled from Gabbs, about 8 miles north, or from Goldyke. Geologic conditions here are similar to other parts of the district; the mineralized zone is in the vicinity of rhyolite intruding the andesite. The ore is quartz containing pyrite, some of which has been altered to limonite. The principal work is a 40–50° inclined shaft having a total of about 200 feet of workings. The mine is equipped with a small headframe with homemade hoist and a combined shop and hoist house in good condition. A camp with good cabin and small out-buildings is about one-quarter mile from the shaft.

The Sullivan patented claim, owned by the Nevada Company of Reno, is in the northwest corner of the district, about 7 miles south of Gabbs. It is reported that the property has been virtually abandoned for years. The workings consist of a 60-foot inclined shaft sunk on a spotty gold occurrence with "dog holes" off the shaft made by occasional lessees. The property has no recorded production and it is doubtful that any appreciable quantity of ore has been mined here.

The Scheebar mercury mine, formerly known as the North Star, is on the northeast slope of Paradise Peak at an elevation of 8,200 feet. As the property is well described by Bailey and Phoenix, it

percent dark minerals, and 10 percent dark rock fragments. The dune is 3 miles from the highway and it was found necessary to walk the last mile as the sandy soil is not negotiable with a conventional car.

Minor beds of diatomaceous earth are found near the highway about 17 miles southeast of Beatty. One of the more prominent outcrops covers an area about 200 feet by 300 feet and appears to be 10 feet or more in thickness.

A volcanic cinder cone 1 mile north of the Las Vegas highway and 23.4 miles southeast of Beatty is being mined for road and concrete aggregate. The cone is held by location by the CindRLite Corporation of Las Vegas who ships the cinder to its building block manufacturing plant in Las Vegas. The company states that the cinders do not show a trace of sulfur. The material is also made available to the Highway Department who has built many miles of road using it as a road aggregate for which it has favorable qualities including an attractive red color. The operation was started in 1946 and apparently the cinder has been shipped from the deposit intermittently since then. Mining is done by slushing with a 1-yard scraper powered by a 66-horsepower double drum hoist. The cinders are pushed into the path of the scraper by a bulldozer. As mining and loading is rapid, intermittent mining can supply raw material for the more continuous block plant operation. Present mining is being done on a bench adjacent to the cone. It is reported that a trench 35 feet in depth dug here was still in cinders at the bottom. This would indicate approximately 500,000 yards in addition to the cone which is about one-half mile in diameter at the base and about 400 feet high.

In reference to the cinder cones in Crater Flat as well as the above-mentioned cone which is 10 miles south, Ball³⁸ writes an excellent description. He refers to the above cone as 4 miles east of Rose's Well. An excerpt from his writing follows:

The cones are gently depressed and are usually superimposed upon circular basalt flows. The flows present ropy surfaces, cross fractures produced during the flow of the almost solid mass, and caverns formed by the onflow of the liquid interior after the surface had hardened into a crust, each a characteristic phenomenon of surface lavas which have been but little eroded. The

³⁸Ball, S. H., U. S. Geol. Survey Bull. 308, p. 152, 1907.

cones themselves are formed in part of flows, but largely of vesicular lapilli, scoriae, and volcanic bombs. The intimate mixture of these red and black fragments imparts to the cones their magenta-red color. The cone 4 miles east of Rose's Well has on its summit a crater, 300 feet in diameter, which is depressed from 15 to 75 feet below its rim. Sulphur coats the volcanic breccia in the crater. The crater of the cone 7 miles north of Rose's Well has been largely destroyed by erosion, the throat displaying a rubble of vesicular basalt fragments. The beds of fragmental material dip inward toward a common center at the crater of the cone 1½ miles farther north.

Since the eruption of the basalt the cones have been somewhat eroded, calcium carbonate has been deposited in the vesicles, shrubbery has taken root on the lava flows, and a sand dune has been superimposed upon the cone 4 miles east of Rose's Well. The basalt is probably of very late Pliocene or early Pleistocene age.

An area north of Crater Flat which was observed to extend westerly about 6 miles to within 10 miles of Beatty contains continuous beds of rhyolitic pumiceous tuff overlying rhyolite lavas. In the more eastern part of this area where the beds are better exposed the "pumicite" is found in cliffs about 80 feet high overlain by a pink tuff and dark dacite. Here the material is relatively soft and is composed of unclassified fragments of volcanic ash with particles of pumice to 1 inch in size. A large block of claims were located here in 1946 by John Konzos, William A. Martin, and Elbert Whitney of Beatty. Roads have been built into the area to make the claims accessible.

A clay deposit situated about 10 miles east of Beatty, formerly held by the Elizalde Corporation of Carrara, has been recently relocated by John Konzos and others of Beatty. The material is a hydrothermally altered rhyolite resulting in a clay of high silica content and contains narrow seams of halloysite with a trace of cinnabar.

The Silver Pearl group of perlite claims, owned by Mrs. J. W. Bruce of Fresno, California, is situated about 3 miles east of Beatty. The claims are reported to be 1 mile off the highway and have a road built to them. No known production has been made.

death by accident in the mill. He made small shipments of ore from 1922 to 1935. Settlement sheets show \$15,900 produced from 296 tons in 36 shipments. Included in this are two concentrate shipments totaling 2.9 tons.⁴⁷ Apparently little or no work has been done here in late years. Weed⁴⁸ states that the property was controlled by the World Exploration Company of Fort Worth, Texas, who did a little work in 1927-1928 but suspended operations in 1929. During the operation of the Texas company the property was known as the Hannapah Extension.

The principal workings are off a steeply inclined shaft 310 feet deep. Levels are at 60, 107, 200, and 260 feet, the lower level being under water. All drifting has been west from the shaft following a west bearing vein. Only a very minor amount of cross-cutting has been done in search of parallel veins. There has been much stoping from the 60-foot level to the surface and some between the 60- and 107-foot levels. The 107-foot level is about 100 feet long; samples⁴⁹ here averaged 2.0 feet in width and contained 0.03 ounces gold and 11.5 ounces silver.

The vein is a shear containing a small amount of quartz and an appreciable quantity of pyrite. The main ore mineral is polybasite, a silver antimony sulfide.

Although the water now stands at 220 feet, in the past it has covered the 160-foot level. The water flow is said to have increased considerably at the bottom of the shaft, however, the flow was apparently handled by a small jack type pump found installed. It is believed that dewatering of the shaft would be a minor problem.

Improvements are in generally good condition. The shaft is timbered, has good ladders, and is equipped with 2½-inch air line and 3½-inch water line. The drifts have had some sloughing under stopes but the ground stands well without timber. The headframe and ore bins are in good condition. A small mill consisting of jaw crusher, small Straub mill, and concentrating table is intact. A large sheet iron building serves as hoist house, blacksmith shop, and general shop. One small house on the property is in rehabilitable condition.

The old Hannapah mine adjoins the Richardson on the west. A group of patented claims here is owned by Earl Mayfield and

⁴⁷Data obtained from Mrs. Myra Richardson and from private memo-report made by J. H. Wells and V. E. Kral, 1947.

⁴⁸Weed, W. H., Vol. XVII, p. 1476, 1931.

⁴⁹J. H. Wells-V. E. Kral private report.

James Mayzie of Tonopah. Little is known about the property except that the dumps indicate extensive workings and the shafts are partly caved. Rock on the dump contains much pyrite. Weed⁵⁰ states " * * * located in 1902 and developed by two shafts, 250 feet and 300 feet deep." He refers to some ore on the 250-foot level. It appears that nothing has been done here since the early work.

The Silver Glance Mining Company, controlled by Mark Bradshaw of Tonopah, has one patented claim lying west of the old Hannapah mine. Weed⁵¹ states, "Property was in production prior to 1909 * * * covers gold-silver bearing quartz veins. Mine is reported to have considerable development completed and to have yielded about \$300,000 (probably owner's report) during early operations."

The Silver Moon group owned by the estate of Stephen S. Clark of Tonopah lies west of the Silver Glance. The claims were located in about 1905. Jack Clark, of Tonopah, reports that two cars of ore shipped in 1912 netted \$34 per ton, and a 34-foot vertical shaft on a 2-foot vein contains \$12 to \$15 ore.

The old Bannock mine, also known as the Volcano and located by W. H. Thomas of Tonopah as the Last Hope group, lies in the western part of the district about 5 to 6 miles west of the Richardson mine. The owner states that this property was worked in about 1912 and some ore shipped when the shaft was sunk. The principal work is a dry 265-foot 30-degree inclined shaft. The owner reports that assays vary from \$2 to \$20 in gold, and that one 7-foot vein assays \$6 to \$7, and another 5-foot vein contains 15 ounces silver per ton.

The Sam Jack group of about 14 claims lies at the extreme west end of the district overlooking the Rye Patch wells. The claims are owned by Earl Mayfield, Jack Clark, and others of Tonopah. Several shallow shafts and trenches have been dug on mineralized shear zones in rhyolite. Much of this mineralized rhyolite contains some gold with silver, and the objective has been to develop a large ore body with enough values for a high-tonnage operation. The writer⁵² took samples that contained \$0.10 to \$2 per ton, principally in gold; however, other samples taken by reliable parties have averaged about \$5 per ton.

⁵⁰Weed, W. H., Vol. XV, p. 1221, 1922. (Information probably furnished by owners).

⁵¹Weed, W. H., Vol. XVIII, p. 1602, 1931.

⁵²Wells, J. H. and Kral, V. E., private examination, 1947.

JACKSON (Gold Park)

The Jackson District lies on the west slope of the Shoshone Mountains and borders the Lander County line. As per Thompson and West, gold ore was first discovered here in 1864 by Thomas Barnes and the district was organized as the North Union. In 1878 it was reorganized as the Jackson. In the early days the district was also known as Barnes Park after the park-like amphitheater about 2 miles wide, near the edge of which the claims were located. The Gold Park group which includes the Arctic, Star of the West, and San Francisco patents has, as per Lincoln, a reputed but unrecorded production of \$500,000 to \$1,000,000. Early recorded and recently known production totals \$18,000. The property became involved in litigation in 1911 and very little production has been made since then.

Preliminary reports by Bernard York (1935) on the Gold Park group and the War Eagle group are on file in the office of the State Bureau of Mines.

Geology. A Carboniferous (?) meta-andesite is the oldest rock in the area and is the host for the quartz veins in which the mineralization occurred. A Tertiary rhyolite tuff overlies the andesite in much of the district and is found in fault contact with the andesite in some of the workings. Siliceous rhyolite dikes were found intruding the andesite. Their relationship to the rhyolite tuff is not known. The ore is always quite quartzose and contains varying amounts of galena and pyrite with a little chalcopyrite in some places. The sulfide minerals are partly oxidized near the surface. Ore values are principally in gold with a varying gold-silver ratio.

Faulting has been rather severe in the district and in the Gold Park group post-mineral faulting has in some places lost the ore, in addition to increasing the difficulty of exploration and development by displacement in other areas.

Properties. The Gold Park group consisting of the Star of the West, Arctic, and San Francisco patents, and several unpatented claims, is in the Gold Park basin at an elevation of about 7,500 feet. It is about 10 miles south of the State Highway Maintenance Station and the Brown Ranch on U. S. Highway 50. The Nye-Lander County line passes directly through the property; however, nearly all of the workings are on the Nye County side. Albin L. Nelson of Gabbs and Walter F. Bowler of Fallon are the owners. Discovery of the property was made in 1880 by Frank Bradley and others who sold to the Nevada Mining Company. This company erected a stamp mill which they operated but a

short time. In 1882 they recorded a production of \$12,787 from 1,353 tons. In 1919 Robert S. Todd took over the property and organized the Star of the West Mining Company. He installed a 50-ton mill in 1921 which made a trial run only. In 1927 the present owners purchased the patented claims at tax sale and have made only minor shipments since then. Production prior to the present ownership is only partly recorded as considerable ore was taken from the two producing veins, namely the Arctic and the Star of the West, particularly the latter which has been worked out within the explored area. During the present ownership the Arctic has produced about \$1,500 from 59 tons and the Star of the West \$3,700 from 43 tons. The mineralization in these two veins is principally gold and silver with lead and some copper. All work has been done in the oxidized zone, therefore, both the sulfides and oxidized minerals of lead and copper are present. As the gold and silver content goes up with that of the base metals, the lead and copper minerals act as a guide in selective mining. The Arctic and the Star of the West are entirely separate veins about one-quarter of a mile apart and are usually referred to as different mines. Both are quartz veins in Carboniferous (?) meta-andesite.

The Star of the West vein strikes N. 30° E. and dips about 50° SE. Its width varies from a few inches to 5 feet. The vein is opened by three adits driven southwest, the upper two having 120 feet difference in elevation and the lower being 100 feet below the middle adit. The lower adit is about 900 feet long and terminates near a major fault that cuts off the vein on the northeast. The portal of the lower adit is caved. The middle adit is open throughout and has about 1,000 feet of drifting on the vein. Two intermediate levels reached from the middle adit have a total of about 700 feet of drifting. The ore appears to be cut off on the southwest by another major fault and the workings terminate here in this direction. Not enough work has been done to learn much about this fault, however, the continuation of the same or a similar vein found southwest of the fault in a stope off the upper intermediate level leads one to suspect that the vein is displaced only slightly. The upper adit is 325 feet long and has a 100-foot cross-cut. The portal of this adit is caved. As the fault cutting the northeast end of the vein is at the portal, all of the upper adit is on the vein, and it appears to be stoped to the surface for nearly its full length. The middle adit drains the workings above it and the lower adit drains the northeast part of the middle adit. The southwest workings of the middle adit are not drained as water

a shaft connecting with the upper one. The workings total about 300 feet. The dump of the longer adit, representing about 200 feet of drifting is reported to assay between \$8 and \$10, principally in gold. Improvements consist of a two-room house, garage, and mill building all in good condition.

JOHNNIE

The Johnnie district lies in the extreme southeast part of the county. It includes the west slope of the northwest end of the Spring Mountains and the east slope of the Montgomery Mountains. The region is typically arid and elevations range from 3,000 to 4,000 feet. Fair desert roads make all mining properties in the area easily accessible. Water is piped to the camps from springs in the Spring Mountains. No transmitted electric power is available, but plans are on foot to bring power to the ranches in Pahrump Valley 15 miles south of the old town of Johnnie.

It is reported that the several properties in the district were discovered in 1890 by a party of men from Indian Springs. The early discovery of the Johnnie district is not surprising as the white quartz ledges outcrop prominently and may be seen for considerable distance.

The recorded production through 1913 is \$382,681 from 64,582 tons. Mr. Charles H. Labbe states that the Johnnie mine itself produced over one million dollars from 120,000 tons during 1910-1913. It appears that the greatest activity in the district was during this period.

The area is well known for its gold placers. Mineral Resources (1920) states that placer gold was discovered here in 1920. W. O. Vanderburg, in the Bureau bulletin "Placer Mining in Nevada," states that in 1935 about 20 men were placering in the district. Dry placer machines were the principal method of recovery. Although the activity has dropped off considerably some placer mining is still being pursued. Vanderburg estimated that the total placer production did not exceed \$20,000.

Geology. A series believed to be Prospect Mountain Quartzite (Cambrian) is the principal host for mineralization in the area. This quartzite contains beds of limestone, shale, and fine conglomerate. Some conglomerate is found in the Johnnie mine region. To the southwest, at the Congress mine, a shale underlies the quartzite which is overlain by limestone. The vein is in limestone and quartzite. The general attitude of the sediments is rather flat lying with gentle dips to the east or southeast. In the proximity of the veins the dips usually become steeper.

The ores of the district usually are in well-defined quartz veins

that may be traced for long distances. Ore shoots are relatively long as evidenced by the length of near-surface open stopes. The principal ore occurrence is gold although some lead reportedly has been mined in the area.

The placer deposits of the Johnnie district would be classified as part "hillside" type and part stream placers. The deposits are always found within short distances of the source, usually less than 1 mile and often within a few hundred feet of the lode. In some instances it appears that the placer was residual, that is, the lode disintegrated and the gold was released nearby in place.

Properties. The Johnnie mine in the northeast part of the district and the Congress mine in the southern area are owned by the Congress Mining Company of San Francisco, California. Charles H. Labbe of Las Vegas was in charge of the last operations at these properties and is therefore familiar with them.

According to a report by Mr. Labbe, the Johnnie mine was discovered in 1890 and over a million dollars produced during 1910-1913. The mine consists of ten patented and several unpatented claims. It is opened by a 45° inclined 900-foot shaft and a 200-foot winze from the lowest level, with the workings estimated to total about 3 miles. Water is obtained by a 4-inch pipe line from Grapevine springs 2 miles distant. The present condition of this line will not permit more than a small flow for domestic purposes. Several buildings on the property are in good condition. Mr. Labbe states that he was on the 900-foot level in 1941 and estimated a large tonnage of mill ore above this level. The 400-foot level was examined in 1949 and ladders were in good shape to this point. The ruins of what is reported to have been an 85-ton amalgamation mill are adjacent to the shaft. Records indicate that only minor work has been done at the Johnnie mine since 1926 and nearly all of this by lessees. B. F. Couch in his Nevada production figures shows \$16,274 from 1,513 tons during 1934-1940.

An attempt was being made to placer the hillside below the Johnnie mine in 1949 by Vincent and F. W. Berry and Kenneth Baldwin. The material was sluiced by high-pressure water and passed through a series of trommels and screens to concentrating tables.

The Congress mine, originally known as the Chespa, was discovered about the same time as the Johnnie mine. The property consists of six unpatented lode claims and is situated in the Montgomery Mountains near the old town of Johnnie. As per information from Mr. Labbe the mine was worked continuously from 1890 to 1895 when the lessees and owners had trouble. Two men were

consist of a 100-foot drift-adit connecting with a 60-foot shaft. A small building in fair condition on the property may be seen from Lodi Valley and serves as a means of identity.

The Germany and Japan patented claims, owned by C. I. Burt of San Francisco, are in Germany Canyon south of and below the Lime Dyke claims. A long adit with winze, driven from the floor of the canyon on the Germany claim, is reported to show galena associated with other sulfides.

The Last Chance group of three patented claims, owned by John Poeter of Gabbs, lies on the west side of the Paradise Range north of Germany Canyon at an elevation of about 7,200 feet. The ground has not been worked since the early days and many of the old openings are caved. Couch shows a recorded production of \$5,461 from 166 tons in 1876-1877. Poeter is now installing a tram on the 30° slope between the workings and the road above. The tram is novel in that it consists of a gasoline engine locomotive running on rail-like guides and motivated by reeling in or out a wire rope anchored at the top. It is reported that the workings have been extensively stoped, about 300 feet of stoping being in evidence on the surface. The ore is said to occur in limestone and lime-shale. A 190-foot shaft and another of 50-foot depth are open but not readily accessible.

The Big Springs mine, of unknown ownership, is situated two miles north of the old camp of Ellsworth on the road to the Penelas mine. A small spring lies about one-half mile north of the property, and it is reported that at one time a 2-stamp mill was built below the spring to treat small lots of ore from the area. Narrow quartz veins occur in meta-volcanics near a granitic intrusive. One glassy vein exposed in a caved shaft is about 6 inches wide; it bears N. 40° E. and dips 60° SE. The rather shallow workings are caved and it appears that no work has been done for many years. A report of examination of this property by Bernard York in 1935 is on file in the Bureau office. York sampled a cross vein to the one mentioned above and found it to have a width of 10-18 inches. Although most of his samples were quite low, one ran \$18.70 per ton, principally in gold.

About one-half mile west of the Big Springs mine is another old property. Here the ore zone, which probably contains gold and silver, occurs in quartzite and shale and has a north strike with a vertical dip. Two caved shafts, 60 feet apart and probably totaling 200 feet in depth, appear to be connected by a stope to the surface. The stope indicates an ore width of about 18 inches.

Near the head of Marble Canyon, above Marble Falls, in the

northwest part of the district, much shallow work has been done on narrow veins containing partly oxidized argentiferous galena.⁷² Small shipments have probably been made by "chloriding" the silver-enriched surface ores. The lead content of the ore is usually about 10 percent.

The Eagle group, a tungsten prospect located by Charles Hammock of Mina, lies about one-quarter mile north of Ellsworth. Quartz veins containing wolframite are found in granodiorite. The workings, including a 60-foot inclined shaft and several more shallow holes, appear to be quite old. One news item mentions that J. L. Corlett did some work here in 1931. Specimens of wolframite were found on the dump of the 60-foot shaft; however, no estimate of the quantity of tungsten can be made as the wolframite has been sorted out for years by specimen hunters.

The Esta Buena patent, owned by Thad Holcomb of Reno, lies about one-quarter mile south of Ellsworth at an elevation of 7,200 feet. The nearest road point is at Ellsworth, which is also a source of water. It is reported that the last operation of the property was during 1924-1929. Couch shows a recorded production of \$16,727 from 284 tons in 1872-1874. The ore contains silver bearing tetrahedrite occurring in a 3-foot quartz vein dipping about 45° W. into the hillside. It appears that the vein is in a thrust fault shear zone between granodiorite and limestone, the granodiorite being thrust over the limestone. The workings consist of an inclined shaft on the vein, now caved, which is said to have connected with an old adit at a depth of 284 feet. During 1924-1929, Otto Herz drove a 615-foot adit below this in an attempt to tap the old workings. This work is said to be 130 feet short of its objective and is now caved about 75 feet from the portal. Ore on the dump of the inclined shaft shows much tetrahedrite and it is reported that the dump will average about 10 ounces silver per ton. Some galena was found on the dump of the adit.

The Kohinoor patent is situated about one-half mile southeast of Ellsworth. The property has apparently been abandoned for many years and belongs to the county. A caved shaft has water to about 70 feet of the surface and a dump that indicates about 1,000 feet of workings. The dump material is all granodiorite with some quartz containing pyrite, the oxidation of which gives the whole dump a yellow color. Nothing indicates any production having been made from the property.

⁷²Information from Mr. Conrad Martin, Geology Department, University of Nevada.

tons here in 1941-1942. This latter ore was milled in Francisco's mill on the Indian Camp group.

The Gold Metals ore occurs in Ordovician limestone and the area in the vicinity of the vein is badly fractured. That ore which Francisco mined was allowed to cave and then drawn from chutes. Nothing is known about the continuation of the Little Gray vein to the northwest into Black Mammoth Hill. The Gold Metals has a 300-foot vertical shaft completely equipped with buildings and machinery, some of which is antiquated but useable.

During 1942-1949, Byron Wilson, Charles Deering, and Bud Priester sank a 122-foot shaft by windlass on the Little Gray vein near the Gold Metals shaft. They were following a 2- to 8-inch width of high grade from which 12 tons of sorted ore, shipped in 1938, grossed \$3,792. In 1949 they recorded a production of \$185 from 19 tons which apparently was a trial shipment of unsorted ore.

The Little Gray patented lode claim, owned by the Burdick-Wittenberg estate, was located in April 1905. This claim adjoins the Reliance group on the southeast. The Little Gray vein is opened by a 400-foot inclined shaft with about a mile of workings, and has been inaccessible for many years. As the shaft passes through 50 feet of gravel, the vein was probably first found elsewhere on the claim. Very little lode mining has been done here for many years, although it is believed that placer on this claim has been worked intermittently and some residual placer is still left.

Ferguson⁷⁵ reports that the main ore shoot had a maximum length of 100 feet, was 5-20 feet wide, and was mined from the surface nearly to the 300-foot level. The vein occurs in a mica schist with some slate and quartzite which are all of upper Cambrian(?) age. Most of the production was made by lessees in the early days and little was recorded. Ferguson refers to one of the early day leases that yielded \$120,000 in ore averaging \$22.50 per ton.

The property of the Thanksgiving Reorganized Mining Company consists of the Thanksgiving fractional lode and the Orphant patent. The Thanksgiving was located in 1906. This ground lies on the western part of Mustang Hill, adjoining the Gold Metals claims on the southeast and the Reliance and Mustang on the north.

Part of the Little Gray vein is on the Orphant claim and was worked through the Reliance shaft in about 1939. Mr. Prince

⁷⁵U. S. Geol. Survey Bull. 723, p. 145.

believes that about \$5,000 production may have been made from the Little Gray vein on the Orphant claim. He believes that placer deposits on high bars in the southwestern part of the Orphant may have produced about \$10,000. George Rong and Albert White made a small shipment from a lease on the western part of the claim in January 1949. They sunk an 80-foot shaft and drove short levels on mineralized fractures cutting carbonaceous limestones and shales.

Work on the Thanksgiving vein on the Thanksgiving Fraction was started about 1910 and abandoned a few years later. A 65-70 degree inclined shaft 450 feet deep was sunk on the vein. In about 1937 the Reliance Mining Company unwatered and sampled the workings. They also connected the 200-foot level with the Mustang shaft.

In 1946 the Jefferson Lake Sulphur Company, under the supervision of Robert W. Prince, unwatered the shaft again and sampled the workings. Mr. Prince states that the previous mining had been on a pipe of ore 18 inches to 14 feet wide, with 50 feet maximum length on the strike, and extending from the 326 to 226-level. He estimates that about 200 tons of ore were removed. As per a letter written by L. P. Stevens in 1922, \$3,299 was grossed from 179 tons when he operated the mine in 1912. Stevens shut the property down at that time. No recorded production is shown from the property.

The Thanksgiving vein occurs in the upper Cambrian(?) formation with Ordovician limestone at the surface. The ore is found in pipe-like replacement shoots which, however, are infrequent, due to the tight condition of the formation. The vein itself has a maximum width of 12 inches, is quartz-filled, and nearly barren. The White Caps limestone is about 1,000 feet below this, therefore, some speculation exists as to what the vein may do at such depth. On the 400-level, an altered rhyolitic igneous rock was found. Neither its classification nor origin is clear; it may be a dike or a down-faulted segment of similar rhyolite found elsewhere on the surface.

Water stands in the Thanksgiving shaft about 20 feet below the 200-level, which connects with the Mustang shaft 215 feet distant. In addition to this level there are about 800 feet of workings.

The Mustang mine, now owned by Mark Bradshaw and Emmett Q. Yates, was originally located in April 1905 as the Mustang claims, and relocated in 1922 by Matt Kane and Yates as the Midas group. The surface workings are characterized by large trenches

on gold occurrences in rhyolite. About 40 tons of \$18 ore is said to have been shipped from here in about 1940.

Placer Deposits. Ferguson⁷⁷ summarizes the Manhattan placer deposits as follows:

Placer gold is found in the older gravels, of which remnants exist in places along the sides of the gulch above the present fill; in deeper gravels of the present gulch; and in recent hillside wash. The older gravels have been worked in only a few places. The bulk of the production has come from the gravels that rest on bed-rock in the gulch itself, at depths of 40 to more than 100 feet. This gravel, as shown by the fossils found in the mines, has remained undisturbed since Pleistocene time. The gold content is variable; in a few places the pay gravel yielded over \$50 to the cubic yard, and in most of the productive mines the yield was over \$2 to the yard. The purity of the gold as measured by the bullion returns increases regularly downstream and in the 2 miles of developed ground changes gradually from an average fineness of about 700 to 740. This change is believed to be due to the fact that downstream the gold particles are smaller and present a greater proportionate surface to the action of solvents in the water. As the gold has remained undisturbed for so great a length of time the solvents have had an unusual opportunity for refining the gold.

A little gold has been obtained from the recent hillside wash in the vicinity of the mines in the Cambrian (?) schist.

As easily eroded high-grade veinlets are common in the area, it is to be expected that placer deposits of one type or another would be found well distributed. Such is the case, as placer workings may be found almost anywhere in the district. It is quite likely that the better material has already been treated; however, we may expect that limited placer mining will continue in the area for a long time. Should general economic conditions ever return to what they were in the early thirties, Manhattan is apt to have many placer miners again using various schemes to obtain and wash the gravel. The Nevada State Bureau of Mines bulletin, *Placer Mining in Nevada*, written by W. O. Vanderburg in 1936, describes the mining and washing methods used in this

⁷⁷U. S. Geol. Survey Bull. 723, p. IX, 1924.

area. The bulletin is now out of print but may be consulted in many libraries.

The Manhattan Gold Dredge Company not only conducted the most important placer operation in the district but was also the largest producer of gold in the history of the district.

The dredge was built during the summer of 1938 at a cost of \$700,000. An additional \$300,000 was spent for pipe lines, pumping equipment, and a camp. Stripping equipment was in addition to these costs. The dredge started operating in 1938 with plans to wash 25 million yards of gravel. The operation was under the supervision of John L. James.

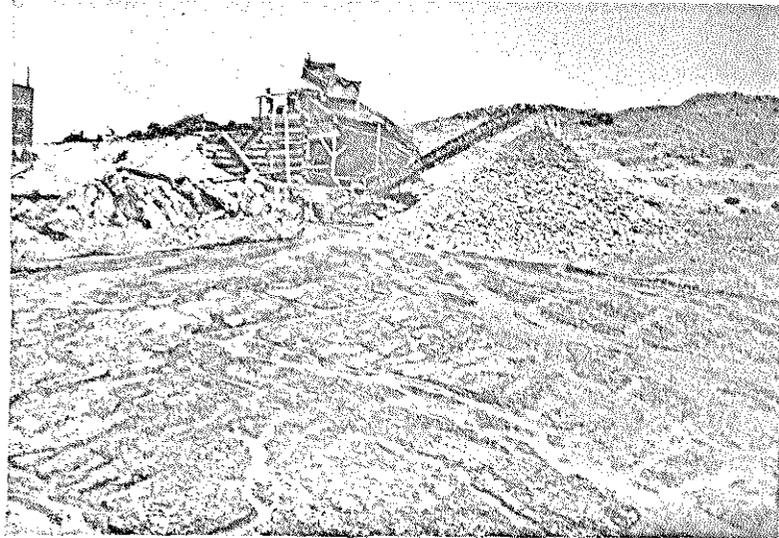
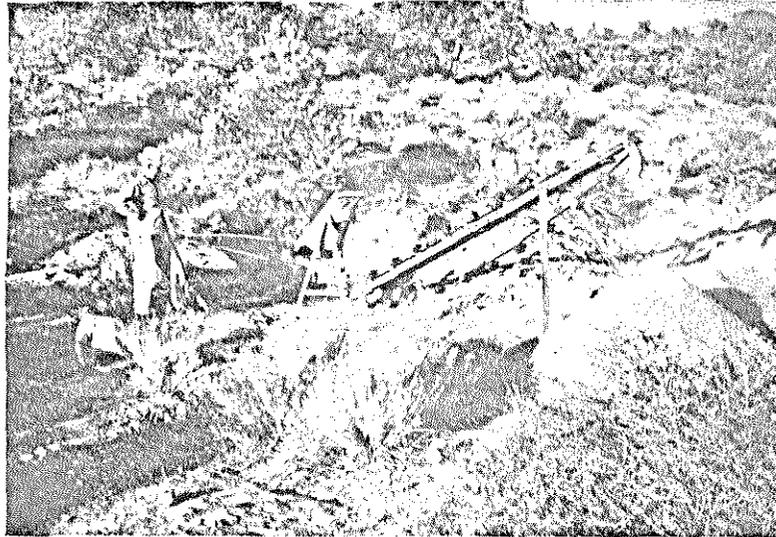
The boat was 172 feet long, exclusive of tailing stackers and bow gantry. It had a 60-foot beam and drew 9 feet of water. The 9½ cubic-foot buckets operated at a speed of 37 buckets per minute and could dig 75 feet below the water surface. The dredge weighed 2,000 tons, was electrically operated, and had a connected load of 2,200 horsepower plus the water pumping load. The total monthly power cost was about \$8,000.

Gold recovery was made by the use of jigs, tables, and Hungarian riffled sluices. The jig hutch product was scrubbed in a Straub ball mill. Amalgamation was used extensively to retain the fine gold.

Manhattan Gulch was dredged from a point well out in the flat portion of the terrain to a point approximately east of the power substation. Dredging was stopped approximately on the Reliance mine ground in 1947. The dredge was disassembled and moved to Copper Canyon, near Battle Mountain, the move being completed in January of 1948.

Since the dredge left, a few small gravel washing plants have operated on high bars that the dredge could not reach. The latest of these is the Fehn-Johnson placer which was operating in 1950 about 5 miles below Manhattan. C. H. Fehn and R. E. Johnson of San Bernardino, and C. M. Pittser of Long Beach, started the operation in the spring of 1948. About 250 yards per day is handled in a semistationary plant. The gravel passes through a trommel with the plus 5/8-inch material being discarded. The undersize goes over a trap and two Pan American 42-inch, two-cell diaphragm jigs. The hutch product is dewatered and elevated to an 18-inch Pan American pulsator jig, which hutch product is barrel amalgamated.

The gravel is mined with a 5/8-yard shovel and hauled in a 6-yard truck. When the operation was visited in the summer of



(12) Present placering near Manhattan.

Upper. George Ruby using a gasoline-powered dry concentrator with a tailing stacker of his own design.

Lower. The Fehn-Johnson washing plant using jigs as the principal means of gold recovery.

1949 the truck haul was about 1,500 feet. From April to September of 1949 about 15,000 cubic yards had been washed.

Occasional small dry placer operations are still conducted in the district. In the summer of 1949, George Ruby, an experienced dry washer operator from the Johnnie district, was testing some of the gravel on the Jumping Jack claim. He was using a conventional dry washer coupled to a small bucket elevator for tailing removal, all operated by a 1½-horsepower gasoline engine. A little gold was found but the "pay streak" was too restricted and thin to pay. Placering had been previously tried in this area.

MELLAN MOUNTAIN

The Mellan Mountain mining district covers a small hill rising about 400 feet above the floor of Cactus Flat 13 miles east across the flat from Cactus Springs. This hill is the northernmost of a small range of such hills finally joining the south end of the Cactus Range 10 miles south. The district is about 38 miles east of Goldfield and 51 miles southeast of Tonopah. It is completely within the Tonopah Bombing and Gunnery Range.

No previous listing or description of mining districts within the State shows the Mellan Mountain mining district; however, among the mining fraternity the area is generally described by this name. It is too far from another district to be included and is, therefore, described here under the name commonly used.

The Mellan Mountain district was apparently discovered by Jess and Hazel Mellan in 1930. The locations were made by Hazel Mellan in October 1930.

Geology. S. H. Ball indicates the hill to be Tertiary Miocene rhyolite. Although a large part of the hill is a rhyolite, some being porphyritic, what appears to be a highly silicified shale is also quite prominent in the district. The rhyolite is believed to be both intrusive and extrusive.

The ore values are principally in gold with some silver and occur in shear zones in the rhyolite and shale. Sample results noted indicate the ore to be 4 to 6 feet in width.

Properties. The Mellan Gold Mines group is the property of principal consequence in the district. It is owned by a corporation controlled by Hazel Mellan of San Bernardino, California. A small production, amounting to about \$1,000, is said to have been made from the claims prior to World War II.

The workings consist of a 400-foot 50-degree inclined shaft with levels at 40, 80, 160, 300, and 400 feet having 700 feet of laterals; and a 100-foot vertical shaft with 40 feet of drift on the

sampling shows values of 5 to 40 ounces silver per ton. In most parts of the workings the gold values vary from \$1 to \$3 per ton; however, one isolated area is said to have a \$28 gold value across a 40-inch vein which is opened for 400 feet of length. Three adits, with a total of 1,600 feet of workings, are the principal openings on the property.

OAK SPRING

The Oak Spring mining district lies near the base of the southeast part of the Belted Range in the vicinity of Oak Spring and south of Oak Spring Butte. The district is 115 miles northeast of Las Vegas and is completely within the Tonopah Bombing and Gunnery Range. It is 58 miles north by dirt road from a point on the Tonopah-Las Vegas highway 57 miles northeast of Las Vegas.

As there are no other recognized mining districts for some distance from Oak Spring, it will be necessary to describe some minor properties under this heading that are a considerable distance from the vicinity of Oak Spring.

Several springs in the vicinity supply enough water for domestic use; however, milling water would have to be obtained from a well. During exploration work, done by the Goldfield Consolidated Mines Company in 1938, four holes were drilled in various scattered spots within about 7 miles of the main part of the district. Water was found in only one, which lies 7 miles east of the central area. This is an 8-inch cased well, 350 feet deep, in which water was encountered at 291 feet. A 15 to 20 gallon per minute pumping test lasted for 55 hours then the pump broke down. A pipe line from the well to the mining properties must pass over a ridge 860 feet above the elevation of the well.

S. H. Ball reports that several prospects were being developed in the district in 1905. The activity at that time was for gold and silver, and some chrysocolla of gem quality was sold as turquoise. Lincoln states that some copper ore was shipped in 1917. In late years, the district activity has been almost completely on the occurrences of tungsten as scheelite which was apparently discovered by V. A. Tamney in 1937. Except for minor gold, silver, copper, and gemstone shipments that may have been made in the early days, about \$6,000 of tungsten concentrates produced in a dry concentrator in 1940 is the only production made from the district.

Geology. The area is made up of limestone intruded by granite and partly covered with Tertiary volcanics. Ball states, "A

stock of granite, approximately three-fourths of a mile in diameter, cuts the Pennsylvanian limestone $2\frac{1}{2}$ miles south of Oak Spring and sends many apophyses into it. The granite forming a dome, set with many exposures in block-like masses, rises above the near-lying limestone."

The tungsten mineralization concentrated in certain beds and along apparent fracture zones in the limestone. Although the scheelite occurs near the granite intrusive only minor occurrences are found directly on the contact. The area is characterized by huge outcrops of garnetite, or tactite, which usually contain little or no scheelite. The ore contains much garnet and other associated contact-metamorphic minerals; however, greater amounts of garnet are found in wide beds almost completely altered to the mineral.

Properties. The Tamney tungsten property, located by V. A. Tamney in 1937 as the Climax group and believed to be presently owned by the Pacific Bridge Company of San Francisco, is centrally situated in the district. The Goldfield Consolidated Mines Company did considerable exploration here in 1938 and again in 1940. In 1939 the U. S. Vanadium Corporation spent a reported \$11,000 doing a very complete sampling job. In 1941, after these companies had relinquished their option and the price of tungsten continued to rise, the present owner became interested in the claims. Except for 15 tons of ore, treated in a local dry concentrating mill for sampling purposes, no production has been made from the claims.

Of four or five ore showings on the property, one is on the granite-limestone contact and the others are apparent bed replacements usually in the hanging wall of the wide, prominent garnet zones. Two or three of these occurrences are indicated to be of size and grade of definite interest as potential ore reserves.

Sampling by the U. S. Vanadium Corporation indicated one ore body of 175-foot length having 1.08 percent tungstic trioxide for a width of 7.3 feet; another body in three parts is indicated to have a total of about 270 tons per foot of depth containing 0.53 percent tungstic trioxide; another smaller area is calculated to have about 1,000 tons to a depth of 25 to 30 feet containing 1.60 percent tungstic trioxide.

Exploration by the Goldfield Consolidated Mines Company consists of an adit with 950 feet of workings driven 315 feet below one of the better outcrops. The adit did not encounter the ore body and it is reported that the workings are still short of the dip

projection of the ore. In addition, the company drove two shorter adits on other exposures. In 1941 the Pacific Bridge Company built more roads on the claims preparatory to driving another adit but work did not begin as the area was closed by government order establishing the Tonopah Bombing and Gunnery Range.

The only improvement on the ground is a large stone cabin in fair condition.

The Indian Trail group, lying southwest of the Tamney group, is owned by Owen R. Speirs and others. During the latter part of 1940 it is reported that 110 tons of ore from here, containing 0.94 percent tungstic trioxide, was milled at a dry concentrator in the district. Concentrates recovered were valued at \$1,150 which is the only known production made from the property. The workings include a shallow inclined shaft opened into an open pit by the last mining operation.

The Crystal claims, owned by the estate of Albert Ninnis and others, lie about a mile southwest of the Tamney ground. It is reported that several hundred tons of ore from here was milled in the dry concentrator; however, the tungsten content of the ore is not known. The scheelite occurs in shear zones in the limestone and is more of a vein type deposit than the occurrences on the Tamney ground. Some relatively high grade, although sporadic, samples were found. The workings include a 30-foot shaft with 20 feet of laterals, a 70-foot shaft connecting with a 150-foot adit, and much trenching. Ore has been taken from the trenches and from a stope between the adit level and surface. Some of the workings on this group are the result of early activity on gold ores in the district.

The Garnetyte Lode claim, owned by Wesley Koyen and Dean P. Thiriot, adjoins the Tamney group on the southeast. In 1940, I. F. Smith leased this claim and milled 2,500 tons of ore in the dry concentrator he built on an adjoining mill site. Tungsten concentrate valued at \$4,000 was produced. As it is known that the mill made a poor recovery, the ore is not as low grade as it appears. The principal work on the property is a large open cut in a hard garnetite bed from which the ore was mined. The Smith mill was removed shortly before World War II.

The Michigan Boy group, owned by Ed Lane of Groom, Lincoln County, lies about 6 miles southeast of the central portion of the Oak Spring district. Partly oxidized argentiferous galena occurs in a vein in flatly lying calcareous shale. As exposed in surface workings, the vein can be traced for several hundred feet; it is 8 to 24 inches wide, strikes southwest, and dips about 65° SE.

The workings consist of a 50-foot inclined shaft, several shallow shafts and holes, and a few trenches. Ore piled on the dumps of the larger openings contains 11 to 16 ounces silver per ton and 1½ percent lead.

The Rainstorm group, owned by F. A. Monson of Las Vegas, lies 10 miles southeast of the Oak Spring district proper and about 15 miles southwest of the Kelley mine in the Groom district. The property is reported to contain lead, silver, and gold ore; 80 tons of which was shipped prior to World War II and said to contain 55 percent lead, 25 ounces silver, and 0.25 ounces gold per ton. Two samples of the vein, taken by an examining engineer, averaged 31.5 percent lead, 0.07 ounces gold, and 11.6 ounces silver per ton. Workings are said to consist of a 220-foot shaft, a 150-foot adit, and several shallow shafts and cuts.

The Old Glory patented claim, owned by Arnold R. Burr and others, is situated 10 miles southwest of the Oak Spring district proper and 3½ miles southwest of White Rock Spring. It is sometimes erroneously considered in the Kawich district which is 27 air line miles northwest. The claim was patented in about 1927 and it appears that the last work was done about that time. A completely caved near-surface adit and shallow shaft were driven on shears in a highly altered calcareous shale. Samples of the mineralized zone indicate a low silver content.

A deposit of "bone" magnesite occurs in limestone near beds of chert, 14 miles north of U. S. Highway No. 95 and 2 miles northeast of the Oak Spring road. The deposit is largely low grade; however, some sorted magnesite ore contains 43.6 percent MgO, 2.1 percent SiO₂, and 3.4 percent CaO. Ownership of the claims is not known. This deposit is also inside the Tonopah Bombing and Gunnery Range.

REVELLE

The Reveille district is in the northern part of the Reveille Range and includes the area on both sides of the range, but does not include the northern tip of the Reveille Range which is known as the Arrowhead mining district.

The district has two principal camps, Old Reveille and New Reveille. The former is 2 miles or less air line northeast of the latter, and the road distance is 10 miles. The southern camp is on the west side of the range, near its crest, and the northern camp is well down on the east side of the range. New Reveille is reached from Reveille Valley and is 25 miles southeast of Warm Springs on the Tonopah-Ely highway and 74 miles from Tonopah. Old Reveille is 21 miles by road from Warm Springs by way of

westward and dips about 15° N. It has yielded ore for 900 feet down the dip, or less than 350 feet vertically below the outcrop. The Keane vein dips to the south and has proved productive only in the lower levels. The Mariposa vein lies north of the Keane and dips gently to the south. Several rich stringers have been encountered at depth on the footwall side of the Los Gazabo. In the so-called sheeted zone, on the west side of the hill, and the stringer section east of the shaft small veinlets occur so close together that the entire deposit has been mined by the glory-hole method.

The grade of ore mined differs according to the method of mining adopted. From 1910 to 1917, when the Round Mountain Co. for the most part mined its own ores, a large tonnage could be handled economically, and the average value of bullion recovered per ton of ore was between \$6 and \$7. In 1918 and 1919 the leasing system was chiefly used, and small rich streaks were followed by the lessees. During this period the average value of bullion recovered per ton of ore mined was \$35.77. In 1920 the recovered value per ton of ore mined on company account was \$4.73 and that mined by lessees \$52.68.

The range of ore deposition is comparatively shallow. The deepest ore mined, from the 900-foot level of the Sunnyside mine (about 300 feet below the collar of the shaft), is above the water level and about 700 feet below the top of Round Mountain. Elsewhere in the district the productive zone appears to be even shallower.

Free gold is the only valuable mineral obtained, for although auriferous pyrite is present in some veins the quantity is too small to warrant concentration or cyanidation. The gold is intercrystallized with quartz or associated with limonite and minor manganese oxide in small fissures in which quartz may be lacking, and both types of occurrence may be present in the same vein.

The primary quartz veins are for the most part not continuous over long distances. The Keane vein and apparently also the primary veins of the Fairview seem to have followed pre-existing faults. These veins generally do not exceed a few inches in width, and much of the high-grade ore from the top of Round Mountain came from veins scarcely over an inch wide.

The primary metallic minerals present are gold, pyrite, and rarely realgar. The gangue consists essentially of quartz together with accessory adularia and alunite and rarely fluorite.

After the primary quartz veins were deposited, new fissures were formed. This later fissuring was probably as extensive as the original fissuring, but for the most part the later fissures did not follow closely the original veins. The supergene waters that oxidized the auriferous pyrite in general followed the new channels, which crossed the older veins at many points, and iron oxide and secondary gold were deposited along these newly formed fissures.

The result is a second type of vein which consists of a fissure filled chiefly with mixed oxides or iron and manganese, the iron in excess of the manganese. Commonly the adjoining country rock is shattered for some distance from the major fissure, and in many places the smaller parallel fissures are the more productive. Crushed fragments of vein quartz occur here and there, but in some of these fissures no gangue minerals other than limonite and pyrolusite are present. The gold is usually inclosed in limonite or manganese oxide, in the middle of the fissure. The gold in these veins differs from that of the quartz veins in that distinct individual crystals are absent, and it occurs in small thin plates or delicate flat feathery crystals, that never show the greenish tinge commonly seen in the gold from quartz veins.

The veins of Round Mountain and the neighboring hill to the southeast have yielded placers, which are in places exceedingly rich. Most of the placer production has come from the immediate vicinity of Round Mountain, but placers have also been mined in the low ground south of the ridge between the Fairview and Sunnyside mines.

In the early days of the camp good returns were obtained from surface material on the slopes of Round Mountain worked by dry-washing machines. Water, however, was soon brought from Jefferson and Shoshone creeks and hydraulic mining commenced. This supply was insufficient, and in 1915 the Round Mountain Co. completed the installation of a 9-mile pipe line to bring

shipments in 1906.⁹² In 1913 a 2-stamp mill is said to have been in operation. Later a larger mill was erected and in 1929⁹³ a 50-ton flotation mill was installed at the Blue Horse mine. It is believed that the mills operated but a short time.

A few buildings remain in the town of Silverbow and it appears that at one time it was a fair-sized mining camp, having a hundred or more population. As late as 1926 there were about 50 people in camp following a high-grade strike.⁹⁴ Roads are in fair condition, it being possible to reach the camp either from the north by way of Golden Arrow, or from the southwest through part of the Tonopah Bombing Range. Water is obtained from nearby springs.

Geology. Ball⁹⁵ describes the district as follows:

The north end of the rugged Kawich Range is, with unimportant exceptions, composed of rhyolites and other siliceous eruptive rocks. The ore deposits lie in rhyolite, which in the vicinity of veins is either kaolinized to a soft chalky mass or silicified, the latter alteration being perhaps more common. The silicified rhyolite is sometimes flinty in texture and is very resistant to erosion, and in consequence forms prominent minor ridges parallel to the veins. In the kaolinized facies the feldspar phenocrysts are either kaolinized or removed in solution, while biotite, if present, is altered to a silvery micaceous mineral. Either facies may be intensely stained red, brown, or yellow by iron salts.

The more important prospects are located in parallel quartz veins or lenses which widen, thin, and often play out, forming mineralized bands whose strike in the district is in many cases north of west. The individual quartz veins vary in width from a fraction of an inch to 5 feet, and these are often connected by minor cross veins. While in many cases the quartz was deposited along pre-mineral faults, in others it occurs along joints, which sometimes form intersecting systems. Quartz likewise often fills the spaces caused by brecciation and forms in solution cavities in the rhyolite. The quartz is, as a rule, white and translucent or colorless and transparent, although in the Blazier tunnel a single vein of

⁹²Lincoln, F. C., p. 182.

⁹³Weed, Vol. XVIII, p. 1600, 1931.

⁹⁴Clifford, Christina; widow of Tom Clifford, one of the early locators; personal interview.

⁹⁵Ball, S. H., Bull. 275, p. 65.

amethyst was noted. Crystal-lined vugs are common. Crustification is often beautifully developed, fortification-agate and mammillary forms being common.

The quartz is more or less stained by iron salts, rarely by malachite. In the quartz specks of stephanite, ruby silver, silver chloride, and probably other silver ores occur. Of these, silver chloride is certainly a secondary mineral, and to a limited extent is disseminated in the country rock. Gold occurs free. Silver is the predominant metal, and \$1 in gold to \$3 in silver is perhaps an average for the whole camp, although in some prospects the silver values are twenty times those of gold. The ore runs from \$6 to \$250 per ton, while higher values are reported. Since the writer's visit strikes in which gold predominates over silver have been reported.

Properties. The Blue Horse mine, owned by the estate of Ellen McNamara and others of Tonopah, is 1½ miles southeast of the town. The property has had extensive work done on a northwest bearing vein 2-4 feet wide dipping 70° NE. The rhyolite near the vein is silicified, therefore forming a ridge which the vein follows about 1,000 feet. A 100-foot shaft, several cuts, and a 300-foot adit at the northwest end expose the vein along this distance. The adit, now caved at the portal, has had much stoping and appears to be the most recent work. The vein at this end has a very cherty appearance.

This property has had considerable work done in the past, and in 1929 it was equipped with a 50-ton flotation mill which has since been removed. The Silverbow Consolidated Mining Company was operating the property at this time. Weed⁹⁶ states,

"In mid-1929, company was employing 11 men and mill was operating 16 hours per day, treating 25 to 30 tons of ore ranging from \$15 to \$20 to the ton." It is said that this company paid \$18,000 in royalties on a \$35,000 purchase price, but, did not complete the purchase.⁹⁷ The company sunk a shaft a considerable distance from the vein but apparently did not cross-cut to the ore as no vein material is on the dump. The only improvement now on the ground is one building in habitable condition.

The Silver Glance group, owned by Mrs. Christina Clifford of Reno, and others, adjoins the Blue Horse on the north. This property was located by Ed Clifford in the very early 1900's,

⁹⁶Weed, W. H., Vol. XVIII, p. 1600, 1931.

⁹⁷Personal interview with Frank Bell, Tonopah, part owner of the Blue Horse.

believed to be in 1900 or 1901.⁹⁸ If correct, this was probably the earliest discovery in the camp. Much of the work on the property was done by Tom Clifford prior to his death in 1928. He made small shipments and during 1940-1942, lessors shipped 160 tons of ore averaging about 35 ounces silver and 0.05 ounces gold per ton. Mrs. Clifford has copies of the smelter returns of lessee shipments.

The workings include several short adits and a lower adit which is equipped with car and track and a blacksmith shop near the portal. The country rock here is rhyolite; the ore is quartzose and contains pyrite.

The Catlin group lies about 2 miles northeast of Silverbow in the next canyon north of the Silver Glance. It is owned by Mrs. Jennie A. Curieux and others of Tonopah. This is one of the older mines in the district, shipments having been made from here as early as 1906. Couch shows 241 tons having a total value of \$3,672 shipped from the claims in 1941. Although some underground mining was being done at this time, it is understood that much of the ore came from dumps.

The ore occurs in a quartz vein 2 to 8 feet wide, bearing easterly and dipping 68° S. The silver is found as the chloride near the surface and in sulfides at depth. Rhyolite is the country rock here as elsewhere in the district.

Mrs. Curieux furnished the following information:

A cross-cut adit, started at the bottom of the gulch below the outcrop, cuts the vein at a distance of 83 feet. A drift extends east on the vein about 60 feet from the adit. A portion of the ore above this drift has been stoped. West of the adit a short drift connects with a shaft 94 feet deep below the adit level. The west side of the shaft has been stoped for a short distance below the adit level and this stope extends to the surface. At the bottom of the shaft, drifts extend east and west on the vein for distances of 15 and 50 feet, respectively. Short cross-cuts, both north and south from the main workings show small quartz veins.⁹⁹

The workings also include several other shafts ranging from 60 feet to 100 feet in depth.

The Hillside mine, in the same part of the district as the Catlin, is reportedly owned by Lawrence Karr, George Dyer, and C. E.

⁹⁸Personal interview with Mrs. Christina Clifford.

⁹⁹Answer to Nevada State Bureau of Mines questionnaire.

Holmberg of Tonopah. The mineral occurrence here is said to be similar to the Catlin group.

The workings include an adit with 700 feet of laterals and 500 feet of raises and winzes with sublaterals, a 300-foot adit with 100 feet of other workings, and several shallow shafts. Couch shows a production of \$7,307 from 285 tons shipped in 1941. It is believed that most of this ore came from the mine workings.

The shipments from the Catlin and Hillside mines were made by William Anderson and David Eason of Tonopah, who were leasing both properties in 1941.

Several other properties in the district, which apparently now are abandoned, have had much work done on them in the past. Extensive workings were noticed west of the Silverbow camp and an old mill site may be seen on a small hill south of the town.

STONEWALL

The Stonewall mining district is on the north slope of Stonewall Mountain about 17 miles south of Goldfield. Lincoln states that the district was first prospected in 1905 and that small shipments of gold and silver ore were made in 1911 and 1915.

Geology. S. H. Ball describes the general geology of Stonewall Mountain as follows:

The formations of Stonewall Mountain are, in ascending order, Cambrian limestone, post-Jurassic granitoid igneous rocks, earlier rhyolite, quartz syenite and quartz-monzonite porphyry, Siebert lake beds, later rhyolite, and basalt.

He adds that the Cambrian limestone is practically horizontal except in restricted areas, and,

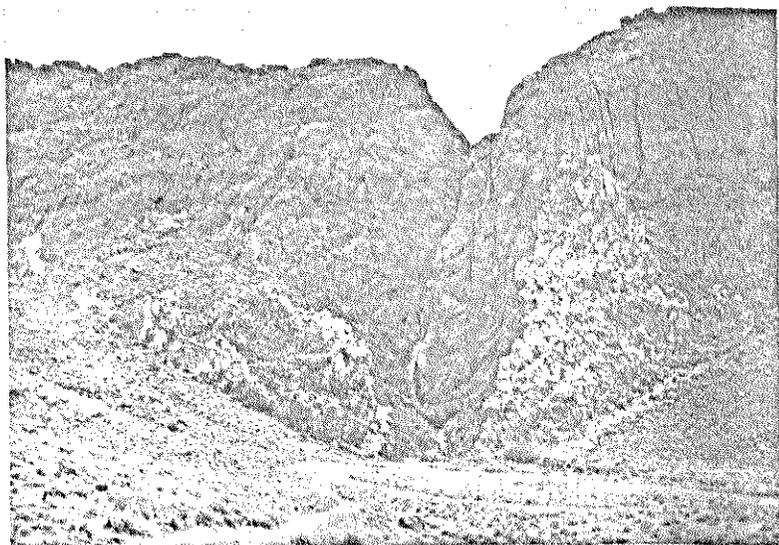
The most striking structural and topographic feature of Stonewall Mountain is the fault on the front of the mountain group, near Stonewall Spring. This fault strikes N. 65° E. and dips 70° N. Minor faults and sheeting parallel to the main fault occur for a distance of one-half mile south of the mountain front.

Properties. The Sterlog group, now abandoned, was apparently on the parallel veins south of the Stonewall Spring fault. The late Ed Giles of Goldfield stated that a 240-foot shaft had been sunk on a vein containing some silver values. The operating company dropped down the hill about 500 feet vertically below the collar and drove a one mile adit to finally intersect the vein.

The adit was driven in the early twenties and the property was

apparently later abandoned. The large dump is a prominent landmark which arouses interest as it is seen from the highway to Beatty. Its only present purpose is for its drainage which is used to water cattle.

Pius Kaelin has a small two-stamp mill at Stonewall Spring



(15) Stonewall Spring. Note the white quartz on the fault face.

with which he concentrates ore he mines at Gold Crater. He usually does his mining during the winter months and stock piles the ore, which he mills in the summer.¹⁰⁰ This is the only known present activity in the district.

TOLICHA (Clarkdale, Monte Cristo, Quartz Mountain)

The Tolicha district is about 30 miles north of Beatty and for the purposes of this discussion is assumed to include the region along Tolicha wash from the Clarkdale area, near U. S. Highway 95, east to the old camp of Quartz Mountain northeast of Tolicha Peak. The mining properties are at elevations ranging from 4,800 feet at the west end of the district to 5,900 feet at Quartz Mountain. Water is extremely scarce in the area. The known sources are Drum Well at the Sarcobatus Highway Maintenance Station at the west end of the district, Monte Cristo Spring (sometimes called Vignola's Spring) one-half mile south of Tolicha Wash and about 3 miles northwest of Tolicha Peak, and a small unnamed spring 1.4 miles south of the old Landmark

¹⁰⁰Personal interview.

camp in the principal part of the Tolicha district. Monte Cristo Spring has been used in the past as a source of water for the mining activity to the east, and twice has afforded water for small prospecting mills set up below the spring to treat ore from the Tolicha area. The small spring near the Landmark mine may have been dry in some years, otherwise it would not have been necessary to obtain water from Monte Cristo Spring, about 5 miles west. Roads generally are in good condition, if proper routes are taken. Quartz Mountain and the Tolicha district proper are reached from a point on the highway 19 miles north of Beatty from where an improved desert road heads northerly. Access to the Clarkdale area is by way of Tolicha Wash, which crosses the highway 28 miles north of Beatty. The Tolicha Wash road between Clarkdale and Monte Cristo Spring is poor.

Discovery of the district was made in 1905 at Quartz Mountain as per Lincoln. He states that little was done until another discovery was made in 1917. Since then intermittent work has been done in the Tolicha area. Much leasing in the early thirties is reported to have produced about \$750,000; however, recorded production from the district is nearly negligible.

Geology. Volcanics are the only rocks found in the district except for a small outcrop of Paleozoic metamorphics mentioned by Ball to be 2½ miles southeast of Tolicha Peak. The volcanics may be generalized as early Miocene rhyolite covered by rhyolite tuffs and breccias and these in turn covered by basalt and basic andesite. Perlite, a volcanic glass with orbicular or pearly structure, of 10- to 20-foot thickness is found between the rhyolite flow and the tuffs for a distance of about 6 miles along Tolicha Wash. In one area, perlite was seen about 1 mile south of the wash, however, the full extent of the flow is not known. The volcanics have a general dip of 10-20° from Tolicha Peak northwesterly, however, due to minor displacements of several faults, the rhyolite is faulted up to the northwest and is therefore in evidence over nearly all of the district. The gold and silver mineralized areas are exclusively in the rhyolite and occur in areas of severe and complex faulting which show extensive hydrothermal alteration.

Properties. The Landmark-Life Preserver group owned by Nick Abelman of Reno, probably has been the most productive property in the district. Gold was discovered here in 1917 and in about 1920 George Wingfield carried out exploration work on the Life Preserver claims under an option to purchase, which was not exercised. It is reported that he shipped two cars of \$15 ore from

The above account of the failure of this company over 80 years ago, in spite of the large monetary value of its production, is of intriguing interest because of similar troubles and failures at many mines extending over the years to the present time. However, the engineer at a flooded or badly caved mine is mentally disturbed between the hopes inspired by accounts of sudden disaster or mismanagement, such as above, crippling a rich mine, and fear that diminishing tonnage and values might be the basic cause.

The last activity at the Murphy was during 1935-1937 by the Ophir Canyon Mining Company,¹¹⁴ which took over the property from Walter Trent. Trent operated the mine during 1917-1923 as the Nevada Ophir Mining Company and was president of both companies. Drainage of the mine was handled through a 12-inch churn drill hole which was drilled 210 feet east of the shaft. It is believed that Trent did little more than unwater and sample the workings. The dumps of the mine show that considerable sorting and screening has been done and it is assumed that much of this was done about this time.

At present, the rock ruins of several old buildings remain and the headframe of the shaft last used also stands. Some of the old buildings could be improved and used for temporary housing.

The Grizzly patented claim, also owned by Mrs. Goldie Lastreta, is just southeast of the claims of the Murphy mine. High-grade gold ore occurs here in a narrow quartz vein that strikes southwest and dips nearly vertically. Only near-surface work has been done on the claim and it is understood that an appreciable quantity of high-grade gold ore has been mined and milled here by small-scale methods. John Martin reportedly mined here in 1924 and processed his ore in a water-powered 2-stamp mill on Ophir Creek. No information on production from the claim is available.

The Gruss mine, consisting of the Aderondike patent and several unpatented claims, also owned by Mrs. Goldie Lastreta of San Francisco, is on the south side of Ophir Canyon near its head. The property is at an altitude of nearly 10,000 feet, therefore winter weather conditions are severe. The road to the claims comes over the Ophir Summit, at an altitude of 10,115 feet, and is usually blocked by a large snow bank just east of the summit. This property was worked by Ronald M. Gruss until his death a few years ago. No known production has been made. The ore occurrence here is an argentiferous galena, partly oxidized and

¹¹⁴Mines Register, Vol. XIX, p. 684, 1937.

containing some copper, occurring in narrow quartz veins in granite. Good grade ore has been reported found here, but it is believed that the occurrences are sporadic. The workings consist of a 300-foot adit, cutting a 20- to 24-inch vein, and a 150-foot adit with a 60-foot winze exposing some high-grade lead-silver ore. In addition, there are several other short adits and some caved workings. Improvements consist of two sheet-iron buildings in good condition. Water is obtained from a large spring near the camp. Any future plan of extensive work on this property should include the reconstruction of the road down Ophir Canyon to the Murphy mine. This would make the mine only about 8 miles by road from the highway in Big Smoky Valley and more easily accessible.

The Dallimore-Douglass claims, located in 1948 by George Dallimore, Robert L. Douglass and Charles H. Pefley of Reno, are about one-half mile southeast of the Gruss mine. The two claims end-line on the ridge separating Ophir Canyon from Last Chance Canyon to the south. On the Last Chance side of the ridge, a north bearing quartz vein containing high-grade galena with chalcopyrite has been exposed in an open cut. The vein zone is about 3 feet wide and dips 30° W. It is made up of several smaller quartz veins which are sometimes together to form a wide face of hard quartz, but usually separated by "horses" of hornfels. Several hundred feet over the ridge to the north are other cuts on quartz seams containing similar mineral occurrences; some of the exposures here may be a continuation of the vein to the south. The deposit is believed to follow a shear zone, probably traceable for 1,000 feet or more, with sporadic occurrences of high-grade lead-silver ore. The silver content is reported to be in the ratio of 1 ounce of silver to 1 percent of lead. The granodiorite contact with the meta-volcanic is one-half mile west of the property and the volcanic becomes more silicified as the contact is approached.

High-grade ore, found on the dump of the best exposure, came from a pocket having a 3-foot face of nearly pure mineral. The possibility of a few larger "plums" or lenses of this sort of ore would make the property attractive as a small scale operation.

The White Horse claims in Last Chance Canyon, owned by J. W. Berg of Round Mountain, are situated about 3 miles above the mouth of the canyon. This and other groups in the general area have been located on narrow veins of high-grade gold ore. The owner has assay returns of several samples taken over widths of 5 inches to over 3 feet, having a gold content of \$3 to \$245 per

The town of Hot Creek was apparently quite active in the early days. Thompson and West state that it was divided into an upper and lower camp and each had a stamp mill, although neither mill operated much. The town was the property of J. T. Williams and was the site of a very elaborate stone building. This building, later gutted by fire, was restored in the early 1900's; it still stands at Hot Creek. It is said that Williams made a sizeable stake from an early discovery in the Danville district, with which he purchased and improved the Hot Creek site. The town is reported to have had a population of 300 in 1868, but is said to have dropped to 25 in 1881.

Tybo itself is very well described by Henry G. Ferguson.¹²⁰ He states that the 2 G lode was discovered in 1871 and a smelter was erected in 1872. The company failed in 1879 after most of the oxidized ore had been mined and they could not treat the sulfides. During the 1872-1879 period, 61,439 tons of ore was smelted yielding 11 percent lead, 27.5 ounces silver, and 0.24 ounces gold per ton. Director Carpenter states that the first mill used a chloridizing roast and amalgamation which recovered only the silver and gold. Later concentrating tables were added to recover galena, but when the heavy sulfide ore containing much sphalerite was reached with depth, milling ceased. In describing this period Ferguson¹²¹ reports that 42,000 tons of ore yielded 20 ounces silver and 0.12 ounces gold per ton.

Ferguson goes on to state that several unsuccessful attempts were made later to reopen the mine. The latest and of most importance was in 1917 by the Louisiana Consolidated Mining Company, with Walter E. Trent, president, who took over the property from Victor Barndt, Sr. and relatives, and erected a bulk flotation plant which closed in 1920. The high zinc content of the concentrate was a detriment as selective flotation was then unknown.

The Treadwell-Yukon Company, with the Bunker Hill and Sullivan Company carrying a 50 percent stock interest, took over extensive holdings in the camp in 1925 and after unwatering and doing considerable exploration constructed a 350-ton selective flotation concentrator which began operation on May 13, 1929. W. H. Blackburn¹²² gives a detailed description of the mill and the

¹²⁰Geology of the Tybo District, Nevada: University of Nevada Bulletin, Vol. XXVII, No. 3, August 1, 1933.

¹²¹Op. cit., Geology of Tybo, p. 43.

¹²²Blackburn, W. H., Milling Methods and Costs at the Lead-Zinc Concentrator of the Treadwell-Yukon Company, Ltd., at Tybo, Nevada: U. S. Bureau of Mines, I. C. 6430, March 1931.

ore treated during the early years of operation. Couch shows the recorded production from this operation to be \$6,781,405 from 465,657 tons during 1929-1937, at a period of low prices for lead and zinc. The mill was temporarily shut down during 1932-1933 and closed finally on September 30, 1937. It was removed from the property during 1937-1939. Leasing has been almost continuous since the company ceased its operation. Couch shows the total recorded production from the Tybo district from 1874 to 1944 to be \$9,789,281 from 596,040 tons. Of this amount, \$392,229 from 28,139 tons was produced from shipments after the mill shut down in 1937.

Geology. Nothing can be added here that is not more adequately covered by Ferguson; therefore a few of his statements¹²³ and a very brief summary of the geology is considered sufficient.

The rocks include marine sediments of Cambrian, Ordovician and Silurian age, two nonmarine formations of probable Tertiary age, and dikes and lava flows also regarded as Tertiary.

The sediments are largely limestones and shales with some quartzite and chert. The dikes and lower Tertiary lava flows are porphyritic quartz-latites which are similar to the general country rock found to the north in the Morey district. Later Tertiary rhyolite flows are found in the western part of the Hot Creek area.

Ferguson also reports:

Practically all the ore so far mined has come from bodies along the 2 G fault, principally bodies that have replaced the dikes of quartz latite porphyry which follow the fault. The primary sulphide minerals are pyrite, sphalerite, galena, chalcopyrite, pyrrhotite, and arsenopyrite. Of these only galena and sphalerite are ore minerals under present conditions. The galena is argentiferous. Nonmetallic minerals are chiefly fine-grained quartz and coarsely crystalline white calcite. Manganiferous calcite is present in a few small veins in the district.

The oxidized minerals which were first mined extended to a depth of about 300 feet. Below this depth oxidation is sporadic. The higher silver content of the sulphide ores in the upper levels, as well as the presence of later pyrite and marcasite, suggest that there has been some supergene sulphide enrichment.

¹²³Op. cit., Geology of Tybo, pp. 8, 11, 12.

Ferguson states that he visited the district in the summer of 1929 and spent three weeks in a preliminary study of the geology. He made a second short visit in the summer of 1930. Considering the short time spent on the ground, Ferguson presents much information and his work is an important addition to the geology of the State; however, it is hoped that further work on this area will at some future time be undertaken. He states:

The structure of the Tybo district is complex, and the writer is by no means satisfied that in the short time available for the work he has been able to make an adequate explanation of all the facts observed.

Properties. The Tybo mine itself is now owned by Herman Budelman, Fred Ninnis, and Philip R. Bradley, Jr. of Tonopah and San Francisco, who took it over from the Treadwell-Yukon Company in about 1947. The principal workings are along the 2 G fault as practically all the ore mined has come from tabular bodies along this structure. The fault-vein has been explored for about 2,500 feet along its strike and to a depth of 1,310 feet. As per information obtained from V. J. Barndt, after Ferguson's report, the company sunk the Hales shaft from the 860-foot level to the 1,310-foot level and drifted on the 860-, 1000-, 1160-, and 1310-foot levels. In referring to the ore bodies the Hales shaft is used as reference and ore east of the Hales shaft is known as the East ore body and that west of the shaft is known as the West ore body. Barndt states that the ore raked to the east as it went down and the East ore body was stoped above the 1310-foot level. The West ore body was mined to a depth of 1,010 feet and was longer on this level than on the 860-foot level. Grab samples from a 10- to 12-foot winze on the 1010 level are reported to average 10.4 ounces silver, 6.1 percent lead, and 7.9 percent zinc per ton. It is said that the water flow at this point was heavy. An average of 138 samples on the 1,010 level gives 10.0 ounces silver, 6.6 percent lead, and 6.8 percent zinc. The last short test-hole drill samples of the east face of the 1,310 level average 3.8 ounces silver, 4.4 percent lead, and 3.7 percent zinc.

V. J. Barndt, of the original Barndt family, lives in Tybo and is the most recent lessee of the Tybo mine. He has been familiar with the area since childhood days and has the assay results of much sampling done during the latter part of the company's operation, plus many maps of the mine.

With a good State highway to the smelter at McGill, there

appears to be an opportunity to find profitable silver ore by exploring the walls in the vicinity of the old rich stopes in the oxidized zone.

The Dimick mine, owned by E. S. and V. J. Barndt, lies west of the Tybo mine workings. Little is known about the history of the property and Ferguson believes the production was probably small. In describing the ground he states:

The lode follows the Dimick fault, which in the developed area has Pogonip limestone on the north and massive dolomite, of the Lone Mountain dolomite, on the south. Narrow dikes of sheared and brecciated porphyry occur in places along the fault plane.

The Uncle Sam fault lies between the Tybo workings and the Dimick. Ferguson states:

It is possible that post mineral movement on the Uncle Sam fault has depressed the horizon of the ore and that exploration of the Dimick fault in depth may eventually be desirable.

Ferguson's map indicates nearly 1 mile of workings off the two shafts, about 200 feet apart. In addition to the workings mapped, an unknown footage is inaccessible.

The Swarbrick prospect, owned by the East Tybo Mining Company and controlled by W. S. Larsh of McGill, lies east of the Tybo mine on the continuation of the 2 G fault. The only reported production has been 1½ tons of sorted ore that contained 130 ounces silver and 60 percent lead per ton. Ferguson states, "The principal workings are along the 2 G fault and consist of a tunnel about 500 feet in length and several smaller tunnels and pits, which prospect the 2 G fault for a distance of about 2,000 feet westward from the point where it is cut off by the fault along the front of the range." The 500-foot adit exposes a few narrow widths of only slightly oxidized galena.

The Ramona group of six unpatented claims, owned by R. R. Redenbaugh and others, lies on the hillside north of the Tybo camp. Ferguson describes the property, "A tunnel 100 feet to the east follows for 100 feet a two-foot zone in a shattered porphyry dike. Along this zone manganese oxide, probably originally present as a carbonate, has replaced the porphyry. The strike is N. 60° E. and the dip is 70° N." It is reported that a few hundred tons of a manganiferous silver-gold ore was shipped to McGill during 1940-1941.

The A. & B. and M. & M. mercury mines are nearly adjoining properties on opposite slopes of the Hot Creek Range near its crest about 6 miles north of the Tonopah-Ely highway. The properties are owned by Lorena Peterson and the Buckley estate. The Petersons live on the M. & M. group and are presently operating it on a small scale, using two pipe-retorts. Bailey and Phoenix show a production of 250 flasks from the two groups. They state:

Cinnabar was discovered on the crest of the Hot Creek Range in argillized rhyolite in 1929, and in 1934 J. Y. Anderson and H. Buckley discovered cinnabar float midway between Warm Springs and Tybo on the western side of the Hot Creek Range. Since that time two properties, the A. & B. and M. & M. mines, have been intermittent producers in the area.

The rocks in the quicksilver-producing area consist of interbedded, flat-lying tuffs and flows of Tertiary Age.

The Ophir and Dexter, also known as the Rattlesnake mine, owned by W. L. Wiswall and others, is in the Keystone area in Rattlesnake Canyon 5 miles air line north of Tybo Canyon. This property has several old shafts up to 150 feet in depth, none of which are in operating condition, and several hundred feet of laterals. Couch shows a production of \$4,789 from 239 tons shipped by the owner during 1941-1945. It is reported that the ore contains silver with tetrahedrite and no gold. The ore bodies are found in limestone.

The Dominion group of two patented and a few unpatented claims is owned by V. J. Barndt. The property is up the canyon from the Ophir and Dexter and has similar mineralization. Workings are reported to consist of two 100-foot shafts and a short adit. Barndt reportedly shipped about 300 tons from the dumps.

A building-stone quarry, 7 miles up Rattlesnake Canyon from the Wiswall property, is owned and operated by Barndt and Crouse of Tybo. In the fall of 1949 they were mining a banded rhyolite for use as building and flagstone material. The rhyolite is a fine even-grained rock difficult to distinguish from sandstone. The banding is nearly flat and occurs in shades of white, grey, pink, brown, and green.

The Uncle Sam patented and six unpatented claims, owned by Bonny Ornelas and others of Tonopah, lie on both sides of the Hot Creek canyon about 2 miles west of the Hot Creek ranch. Some work was done here in the early days of the district. During the past few years, the present owners have built two short sections

of road to the workings and have done additional exploration on a north bearing shear in limestone. The ore is somewhat spotty and contains both sulfide and oxidized silver minerals. The owners report a small shipment that contained about \$9 per ton in silver with some gold.

UNION (Ione, Berlin, Grantsville)

The Union district covers the area near and between Ione and Grantsville. It lies in the Shoshone Mountains, a narrow range on the west side of the Reese River Valley. The mining properties are situated at elevations ranging from 6,500 to 8,000 feet and are usually accessible by fair dirt roads. The nearest paved road is U. S. Route 50 which is about 30 miles from Ione at a point near Eastgate, and about 55 miles distant at Austin. The roads connecting Ione with the highway are improved dirt roads, ordinarily in good condition. Weather conditions will usually allow year-around work, although some properties may be temporarily inaccessible due to drifting snows. Water for domestic purposes is readily available in most of the district; however, enough water for milling can be found in only a few places.

Ore was discovered in the Union district in 1863 by P. A. Haven. The district was subsequently organized, and the towns of Ione and Grantsville were established. Nye County was separated from Esmeralda in 1864 upon petition by the miners of the community, and Ione was designated as the first county seat. Two mills were built to treat the gold and silver ores of the district. The Pioneer, a 5-stamp mill on the lower outskirts of Ione, was apparently to be used on ores originating at Ione; however, it appears that it ran very little until the latter part of the century when it was used for Berlin ore. The Knickerbocker mill, with 20 stamps and 6 roasting furnaces, was located about 1 mile south of Ione and treated the Grantsville ore until 1869 when the activity of the district temporarily subsided. In 1867 the county seat was moved from Ione to Belmont. This, coupled with the decrease in mining activity, was a hard blow to the community. Grantsville again came to life in 1878 and, as per Thompson and West, had a population of 800 and listed 42 business establishments including a brewery and newspaper. The Union district has had an intermittent production from the gold, silver, and lead mines since those early days. Mercury was discovered near Ione in 1907 and as per Bailey and Phoenix, 10,000 flasks were produced prior to 1920. Since that year, the production has been about 50 flasks annually.

Geology. Information from Muller and Ferguson¹²⁴ lists Carboniferous volcanics as the oldest rocks in the district. The Berlin mine and part of the Richmond, 1 mile east of Berlin, are in this formation, which is commonly referred to as meta-andesite or greenstone. These old volcanics are overlain by a Triassic series of slates, conglomerates and limestones. The Grantsville mine and part of the Richmond are in this later formation. The sedimentaries have been intruded by an aplite near Grantsville and by a small granodiorite stock 1 mile south of Ione. Small exposures of the granodiorite were found northeast of the Knickerbocker tailings. The latest formations are Tertiary flows of rhyolite and andesite with which are associated the mercury deposits southeast of Ione and the high-grade stringer gold deposits northwest and northeast of Ione. The Tertiary lavas are found on the east side of the range for the full length of the district and extend to the west side near Ione and at Grantsville. The high-grade gold stringers northwest of Ione have fed nearby placer gravels that have been worked intermittently since about 1909. Although silver, gold and mercury have been the principal economic metals of the district, the Alexander mine at Grantsville has produced large quantities of lead, copper, and zinc.

The Shamrock mine is 1 mile southeast of Ione at an elevation of about 7,500 feet. It is comprised of several unpatented and eleven patented claims, including the Indianapolis which has a production record dating back to 1867. Since 1888, production has been small and intermittent, being made principally by lessees. Total recorded production is \$107,000. A cyanide mill constructed in Ione in 1924, was changed to a table concentrator in 1929; however, a 17-ton trial run is reported to have been the total ore milled. The mill building still stands, nearly all equipment having been since removed. The mine and mill building are owned by the Shamrock Mines Company of Salt Lake City, Utah.

The Shamrock ore occurs in a narrow band usually under 18 inches wide in about 4 feet of quartz in Tertiary andesite. Values are principally silver, the silver to gold ratio being approximately 400 to 1 by weight. The vein strikes northwest and has been explored intermittently for several thousand feet. Production has been principally from the Indianapolis claim which has a 200-foot inclined shaft with about 1,000 feet of laterals. As stopes have been gobbled with waste, it is difficult to estimate the actual

¹²⁴Ferguson, H. G. and Muller, S. W., Structural Geology of the Hawthorne and Tonopah Quadrangles, Nevada: U. S. Geol. Survey Prof. Paper 216, Plate 13, 1949.

amount of mining done. Several shafts have been sunk along the vein northwest and downhill from the Indianapolis, the lowest important opening being an adit on the Crown claim having about 2,000 feet of workings. George Bond and James Ford of Ione, have done much of the recent leasing on the Shamrock and are very familiar with the workings.

The North Star patented claim, also known as the Phillips mine, is a fraction in the Shamrock group of patented claims near their southeast end. The property is owned by Mrs. J. C. Phillips of Reno and C. L. Stephenson of Los Angeles. A 300-foot shaft on the North Star claim caved to within 50 feet of the surface during the earthquake of 1932, making the workings only accessible through the Indianapolis shaft on the Shamrock ground. Although Phillips made a living off this property for many years, shipments were probably small and no production is recorded. The ore is the continuation of the vein on the Indianapolis and is reported to be from 4 inches to 2 feet wide, averaging about \$22, principally in silver. Like the adjoining property, the vein occurs in Tertiary andesite. Besides the caved shaft, the North Star has two other shafts, one 50 feet deep and the other 100 feet deep. The latter, equipped with a hoist and headframe, is near the old caved shaft and was sunk by lessees who are reported to have shipped ore during World War II.

The Bald Mountain Bill property, also known as the Black Diamond or Brown Derby, is about 1 mile northwest of Ione on the southern slope of a bulge in the Shoshone Range. The claims were originally located about 1907 by J. N. Bryant and later abandoned. In the late twenties they were relocated by Bill Culver, from whom the property obtained its name. In 1941 the claims were purchased by the original locator, Bryant, who is the present owner and lives in Reno. A little gold production has been made from high-grade stringers and pockets, which occur in Tertiary rhyolite and are usually associated with jasper. Undoubtedly the weathering of these high-grade stringers are the source of the gold placers lying adjacent to and below the property. As is so common with bunchy high-grade occurrences of this type, most of the work has been done in several relatively shallow shafts, the most recent of which is equipped with a good headframe. The work also includes an 80-foot drift-adit.

The Gold Nuggett Placer group of 11 claims, containing 1,760 acres, lies below the rhyolite gold deposits northwest of Ione. The ground was located in 1948 and 1949 by Joe and Frank Bastian of Round Mountain, and William B. Pate of Tonopah, who

Mineral Resources (1922) reports that the Webster Mines Corporation, an association of W. J. Webster with Seeley Mudd, operated the mine for a short time. John Burgess pumped out the Alexander shaft and made a complete examination of the mine at that time.

Later in the twenties, Jay A. Carpenter, in partnership with a Mr. Bray, operated the mine for a few months. The oxidized ore from the upper levels, which had a higher silver content, was treated in a cyanide leaching plant. Mr. Carpenter then sold out to Mr. Bray who converted the mill to flotation and mined sulfide ore from below the main adit level. The property was then idle for several years, during which time the present owners purchased the claims at tax sale.

In 1939-1940, W. J. Barrows, operating as the Silver Palace Mines, installed a 50-ton flotation mill, which is now on the property, and treated 12,233 tons of ore during the latter nine months of 1941. Making a bulk concentrate, containing silver, lead, zinc, and copper, this company produced about \$100,000. The property was shut down and, in 1942, Ira Kent of Fallon took over the mill for outstanding bills. He operated for a short time and was followed by the Rex Mining and Milling Company of Reno. No record of production was found for either of the latter two operations.

The Alexander and Brooklyn Mines Company, with E. D. Feldman as president and Clyde Collins of Carson City as consulting engineer, began operations in 1945 and, as per information obtainable, received about \$50,000 from concentrates to the middle of 1947. Data of three months operation in 1947 show 4,450 tons milled, containing 5.15 ounces silver, 0.80 percent lead, and 1.87 percent zinc per ton. Fifty-five tons of concentrates produced averaged 308 ounces silver, 42 percent lead, and 12 percent zinc per ton. During this period, mill extraction averaged 76 percent for silver and 72 percent for lead. Silver extraction dropped during the latter part of this period and it is understood that the operation was running without adequate supplies. All this ore, except 193 tons mined underground, came from dumps. The sulfide ore on the lower levels is extremely hard and the ore which was mined from development headings cost \$26 per ton. Little actual stoping was done.

The ore occurs as replacements in triassic limestone. The bodies are irregular and sometimes as much as 50 feet wide. The division between the oxidized and sulfide ores is approximately at

the lower or fifth adit level. In some areas the sulfide ores contain considerable zinc, especially at greater depths. Some dumps show much scheelite and high-grade specimens have been found; however, recent sampling showed the best rock to contain 0.2 percent WO_3 .

The workings consist of five adits connected with a vertical shaft having three levels 50 feet apart below the lower adit. The last underground work was done on the lower levels, below the water table. These workings were unwatered in 1949 by the Coronado-Copper and Zinc Company (the Mudd interests) which made a complete examination of the mine and also did some reconnaissance diamond drilling in the area.

The workings mentioned, total over 1 mile and are sometimes referred to as the Alexander. Across the canyon is an inclined shaft, with considerable work, now partly filled with tailings. This shaft is known as the Brooklyn. It is believed that little or no work has been done here for many years.

The camp has several buildings in good condition and machinery facilities for mining are about as they were during the last operation. A well was developed by the diamond drilling near the camp and may be expected to help the water supply in the event of future operation.

The Coronado Copper and Zinc Company of Los Angeles; Mr. Benjamin H. Sheahan of Reno, the engineer in charge of operations for the Alexander and Brooklyn Mines; and Mr. Clyde Collins of Carson City, are probably the most familiar with the potentialities of the Grantsville property.

A fluorite prospect located in 1941 as the Allied group by Roy C. Ames of Ione, is situated $1\frac{1}{2}$ miles southerly of Grantsville, between Grantsville and Milton Canyons. Twenty-nine tons of acid grade ore was shipped by a lessee in 1948. The area has been classified by Muller and Ferguson as Triassic dolomite. Pockets and bunches of fluorite occurring along a shear in a silicified zone have been opened by minor surface workings. The best exposures are in two pits, one 15 feet long and 5 feet deep on 4 feet of fluorite, and another 6 feet long and 8 feet deep on 3 feet of fluorite.

Another fluorite property, owned by L. E. Murray of Grantsville, adjoins the north end of the Ames ground and extends northwesterly along the ridge toward Grantsville. Discovery has only recently been made, and cuts and trenches expose the mineral.

An antimony prospect in Milton Canyon $2\frac{1}{2}$ miles south of

Properties. Old workings, possibly abandoned, include a 150-foot inclined shaft and an old adit about 100-feet in length. The shaft was sunk on the dip of a 4-foot quartz vein in rhyolite. It appears that the work may have been started on near-surface enrichment of oxidized silver minerals. These enriched surface ores were usually an incentive for deeper work. A cabin on the ground is in rehabilitable condition and indicates that the last work here may have been done in the thirties.

The Pittsburg group, owned by E. J. Reed and Ed Slavin of Tonopah, is said to lie about 4 miles east of the Tolicha road and the old workings of the Wilsons district. A mineralized zone lies in and adjacent to several parallel quartz veins striking north-east. The values are in silver and gold.

The workings include a 300-foot inclined shaft with 40 feet of laterals on the 100-foot level, 175 feet on the 200, and 350 feet on the 300- or bottom level. Samples noted, indicate low silver values and some gold in the workings off the shaft. A 425-foot adit is said to show little indication of ore.

RECOMMENDED REFERENCES

Lincoln, published in 1921, has a very complete list of publications and articles on Nevada of both economic and geologic nature. In 1932 the Nevada State Bureau of Mines published "Metal and Nonmetal Occurrences in Nevada," which brought the list of references up to date at that time. Gianella's "Bibliography of Geologic Literature of Nevada," and Prince's "Bibliography of Geologic Maps of Nevada Areas," published together by the Bureau listed all writings and maps of a geologic nature up to 1945. Following is a list of the more important publications and articles pertaining to Nye County, most of which were published after the above-mentioned bibliographies:

Anderson, C. A. and Cox, M. W., Geology of the Hall Molybdenum Property, Nye County, Nevada: U. S. G. S. Preliminary Report. October 1949. (In open file, Nevada State Bureau of Mines office.)

B. M. I. Milling, Gabbs, Nevada: Mining World, November 1944.

B. M. I. Mining, Gabbs, Nevada: Mining World, December 1944.

Callaghan, Eugene and Vitaliano, Charles J., Magnesite and Brucite Deposits at Gabbs, Nye County, Nevada: U. S. Geol. Survey Preliminary Report, 1948. (In open file, Nevada State Bureau of Mines office.)

Holmes, George H., Jr., Mining Methods at the Brucite Deposit, Basic Refractories, Inc., Nye County, Nevada: U. S. Bureau of Mines I. C. 7543, 1949.

Ferguson, Henry G., Geology of the Tybo District, Nevada: University of Nevada Bulletin, Geology and Mining Series, Vol. 27, No. 3, 1933.

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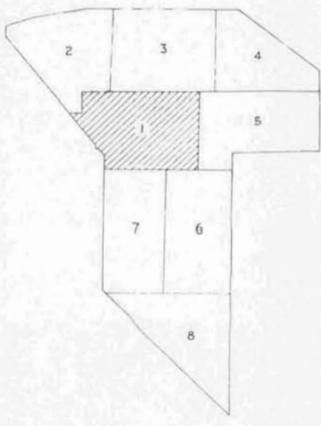
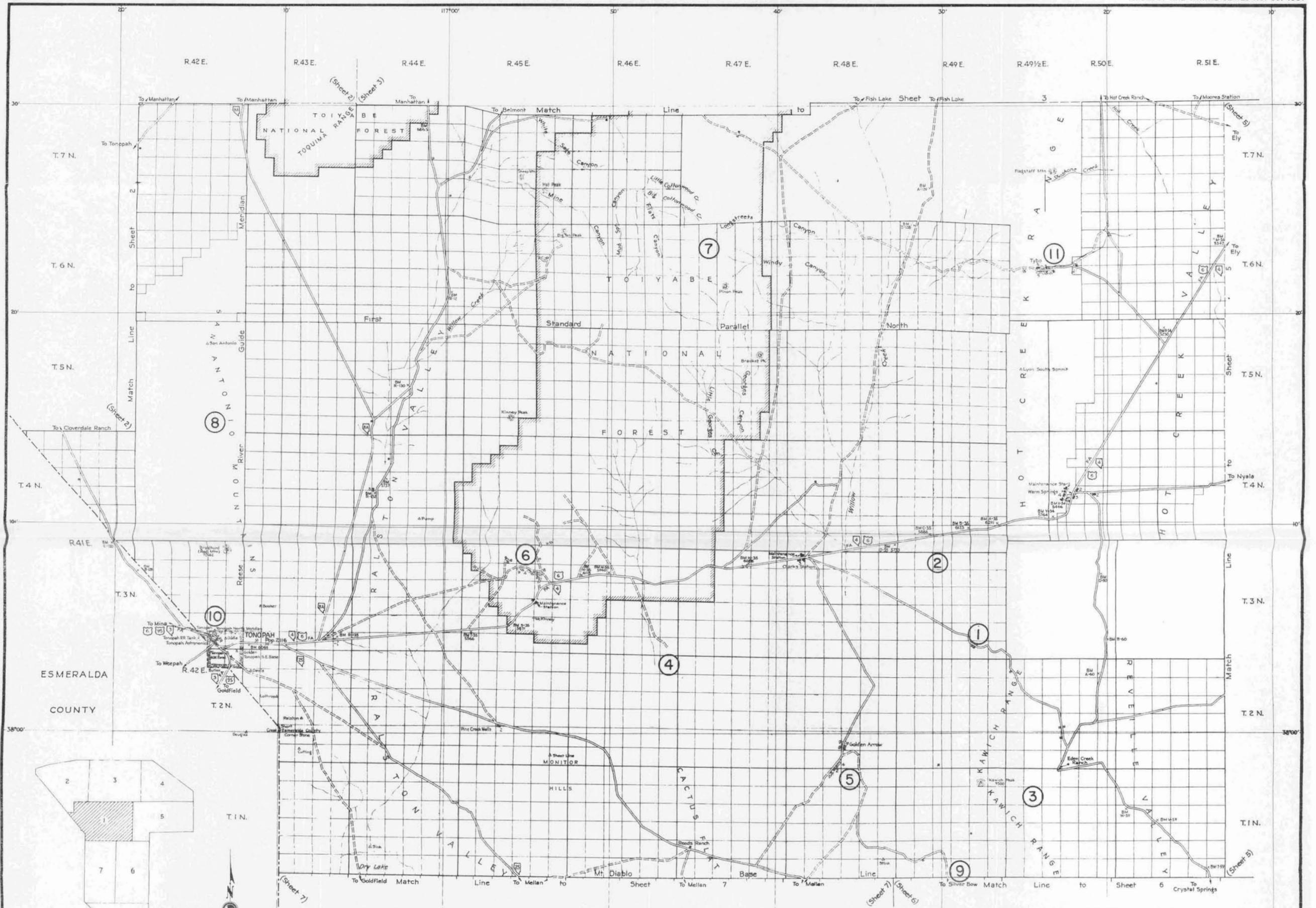
Geehan, Robert W., Exploration of the Crowell Fluorspar Mine, Nye County, Nevada: U. S. Bureau of Mines R. I. 3954, 1946.

Thurston, W. R., The Daisy Fluorspar Deposit Near Beatty, Nye County, Nevada: U. S. G. S. Strategic Minerals Investigations Preliminary Report 3-209, 1949. (In open file; Nevada State Bureau of Mines office.)

Kral, Victor E., Phelps Stokes Iron Deposit, Nye County, Nevada: U. S. Bureau of Mines R. I. 4000, 1947.

Nolan, Thomas B., The Underground Geology of the Tonopah Mining District, Nevada: University of Nevada Bulletin, Geology and Mining Series, Vol. 29, No. 5, 1935.

Round Mountain Gold: Mining World, June 1950.

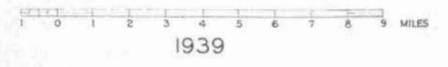


KEY TO SHEETS

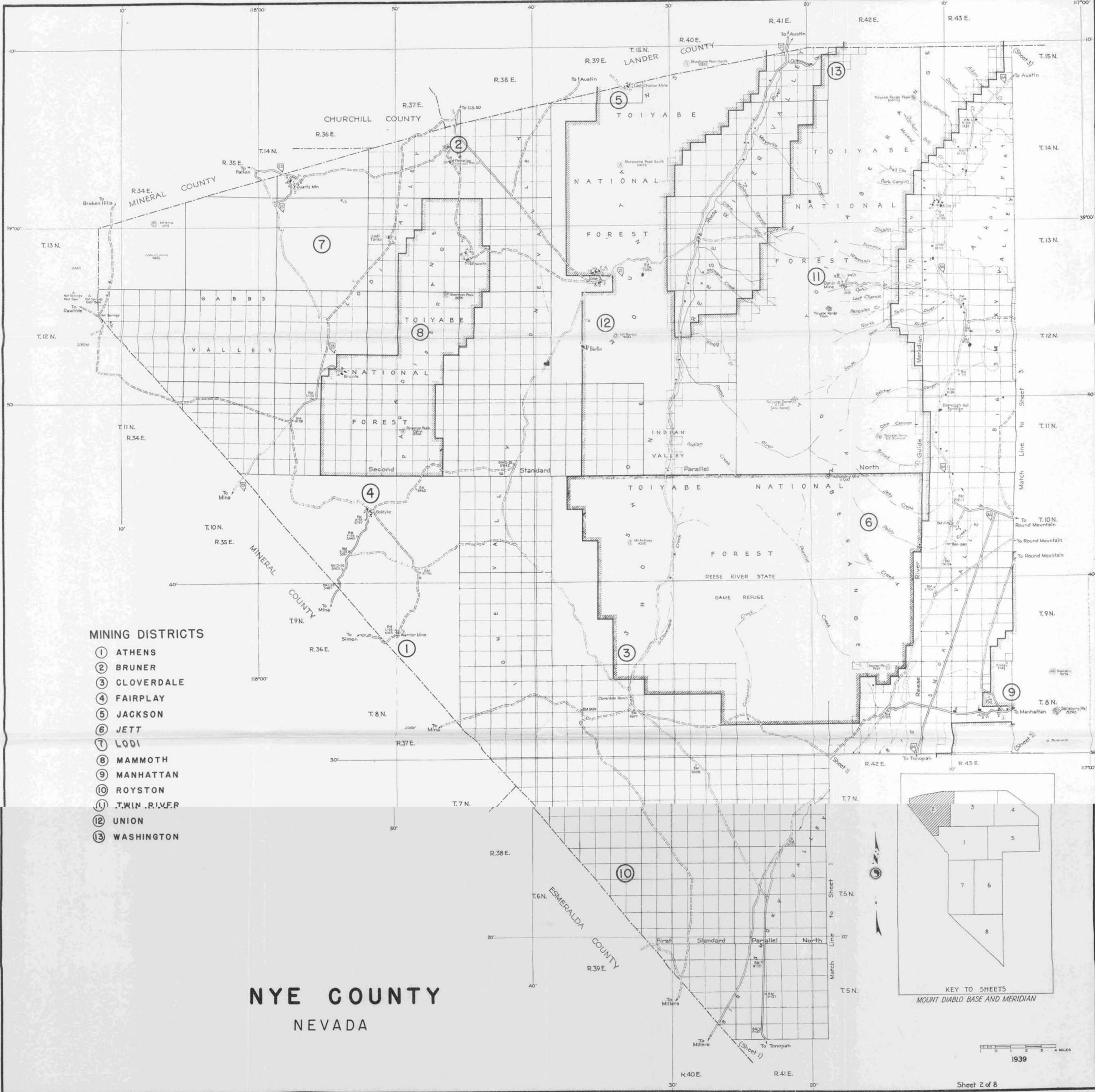
MINING DISTRICTS

- ① BELLEHELEN
- ② CLIFFORD
- ③ EDEN
- ④ ELLENDALE
- ⑤ GOLDEN ARROW
- ⑥ HANNAPAH
- ⑦ LONGSTREET
- ⑧ SAN ANTOINE
- ⑨ SILVERBOW
- ⑩ TONOPAH
- ⑪ TYBO

NYE COUNTY
NEVADA



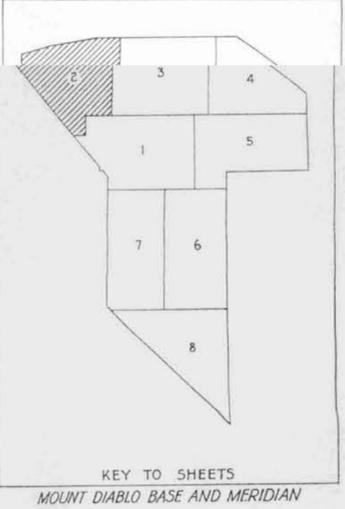
1939



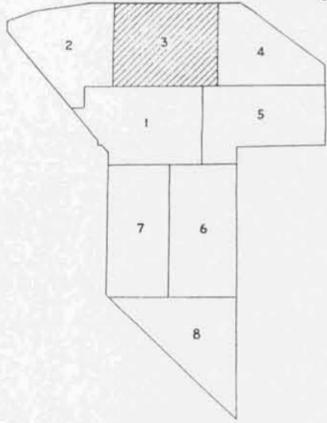
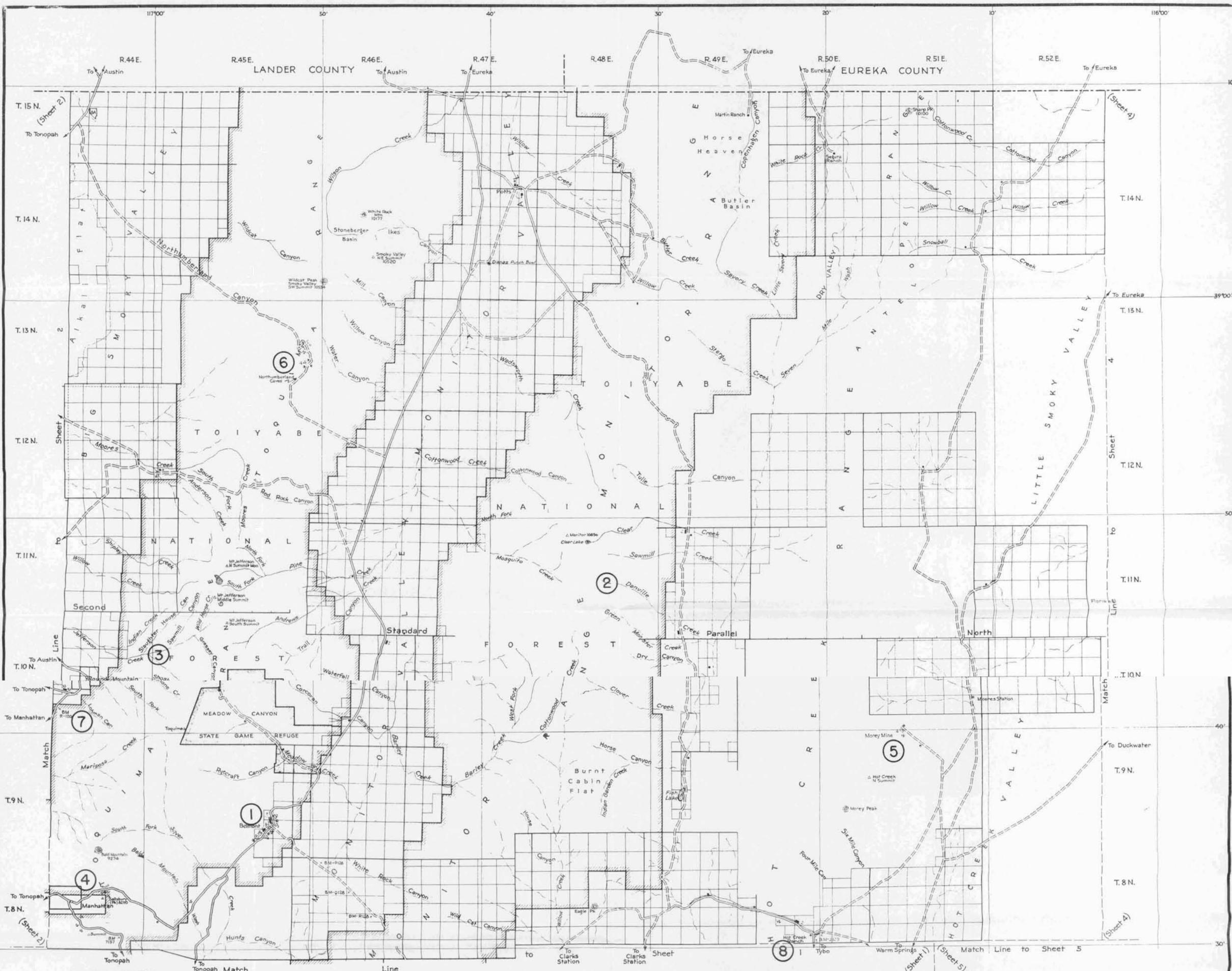
MINING DISTRICTS

- ① ATHENS
- ② BRUNER
- ③ CLOVERDALE
- ④ FAIRPLAY
- ⑤ JACKSON
- ⑥ JETT
- ⑦ LODI
- ⑧ MAMMOTH
- ⑨ MANHATTAN
- ⑩ ROYSTON
- ⑪ TWIN RIVER
- ⑫ UNION
- ⑬ WASHINGTON

NYE COUNTY
NEVADA

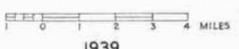


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1939



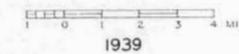
- MINING DISTRICTS**
- ① BELMONT
 - ② DANVILLE
 - ③ JEFFERSON CANYON
 - ④ MANHATTAN
 - ⑤ MOREY
 - ⑥ NORTHUMBERLAND
 - ⑦ ROUND MOUNTAIN
 - ⑧ TYBO

NYE COUNTY
NEVADA



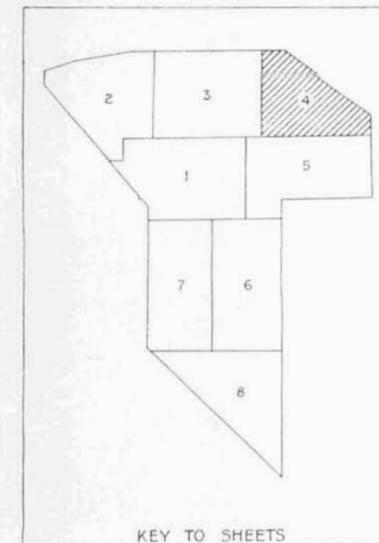
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NYE COUNTY NEVADA



1939

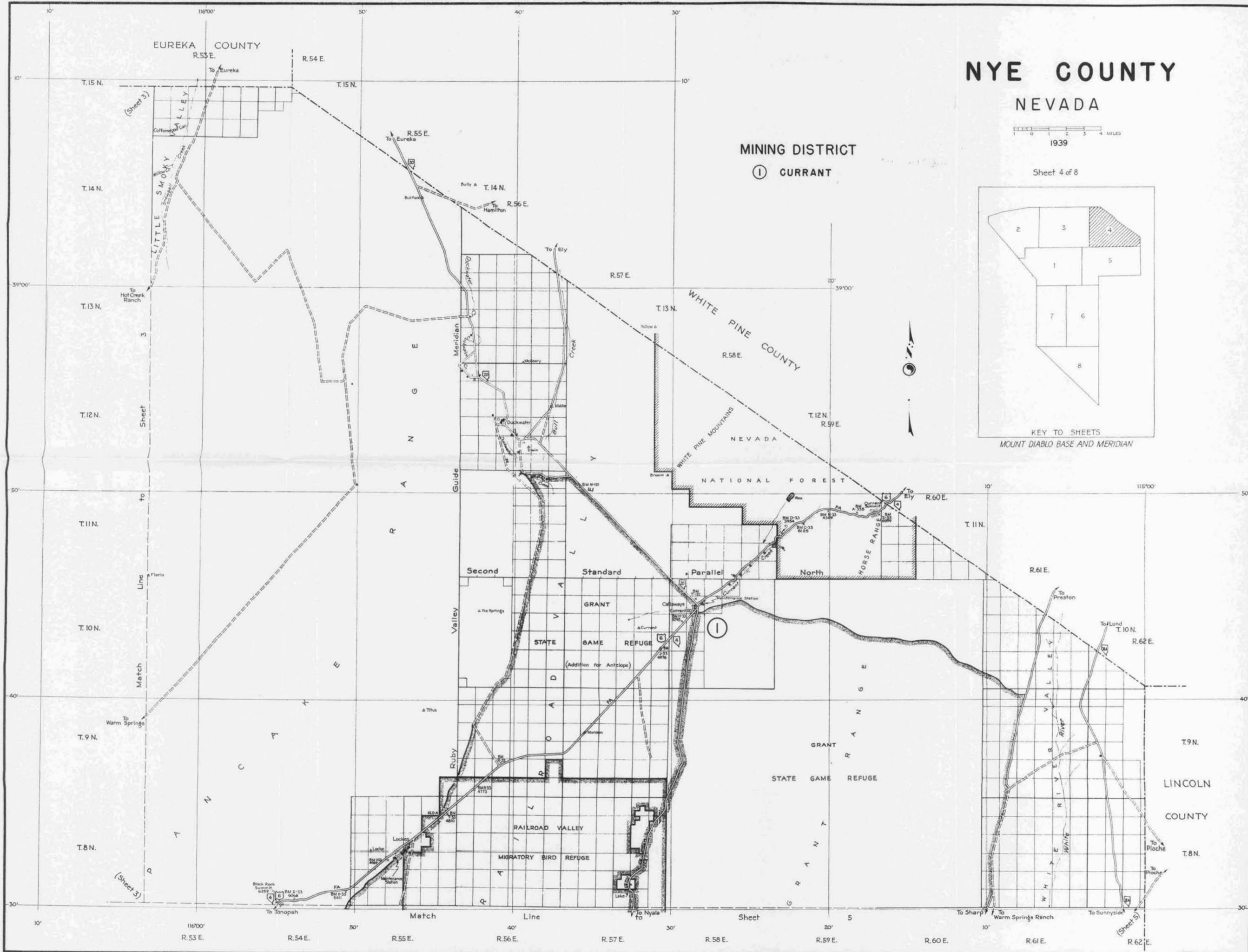
Sheet 4 of 8



KEY TO SHEETS
MOUNT DIABLO BASE AND MERIDIAN

MINING DISTRICT

① CURRANT



(Sheet 3)

(Sheet 3)

(Sheet 5)

Match

Line

Sheet

5

To Sharp

To Warm Springs Ranch

To Sunnyside

Line

Match

Line

(Sheet 3)

Match

Line

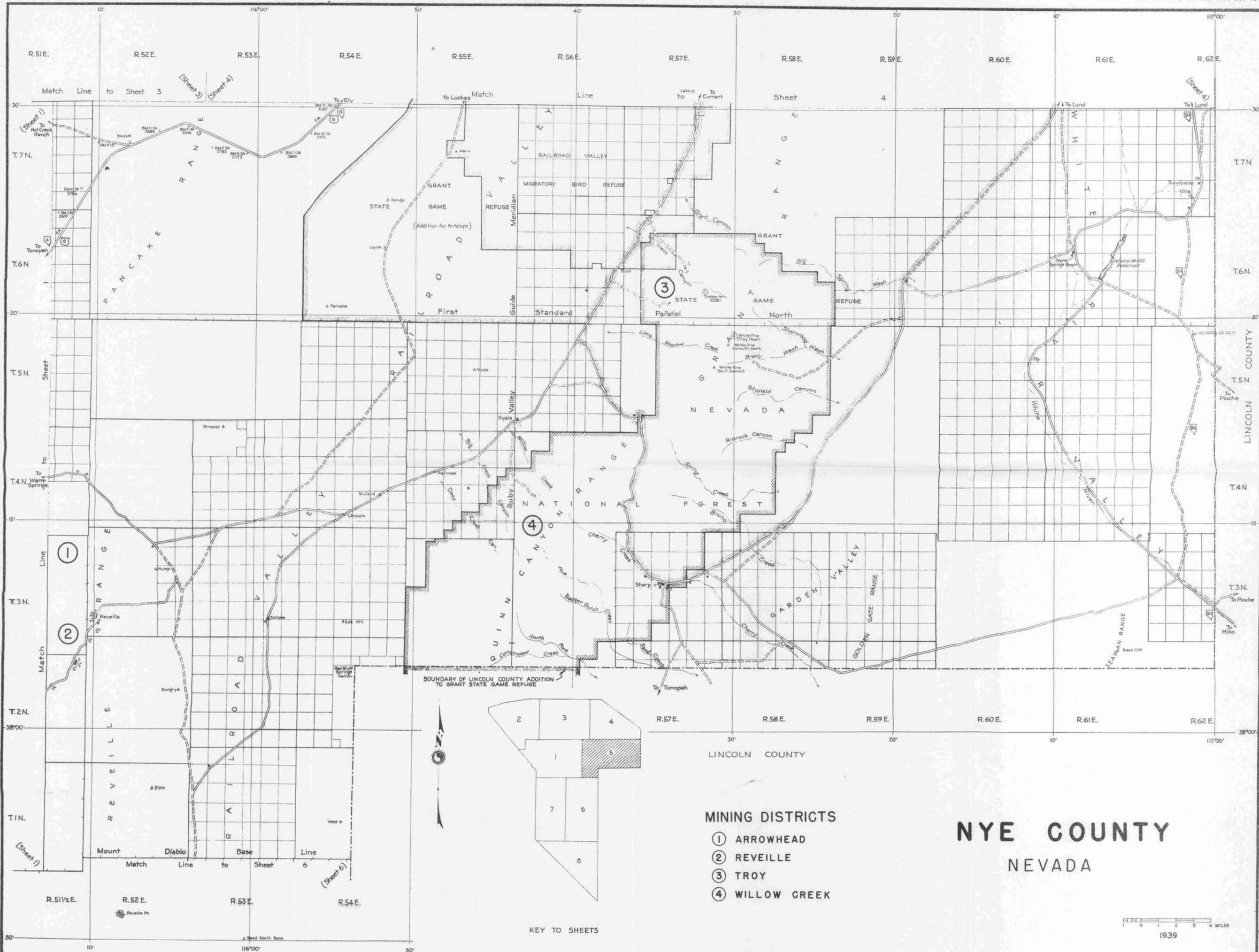
Sheet

5

To Tonopah

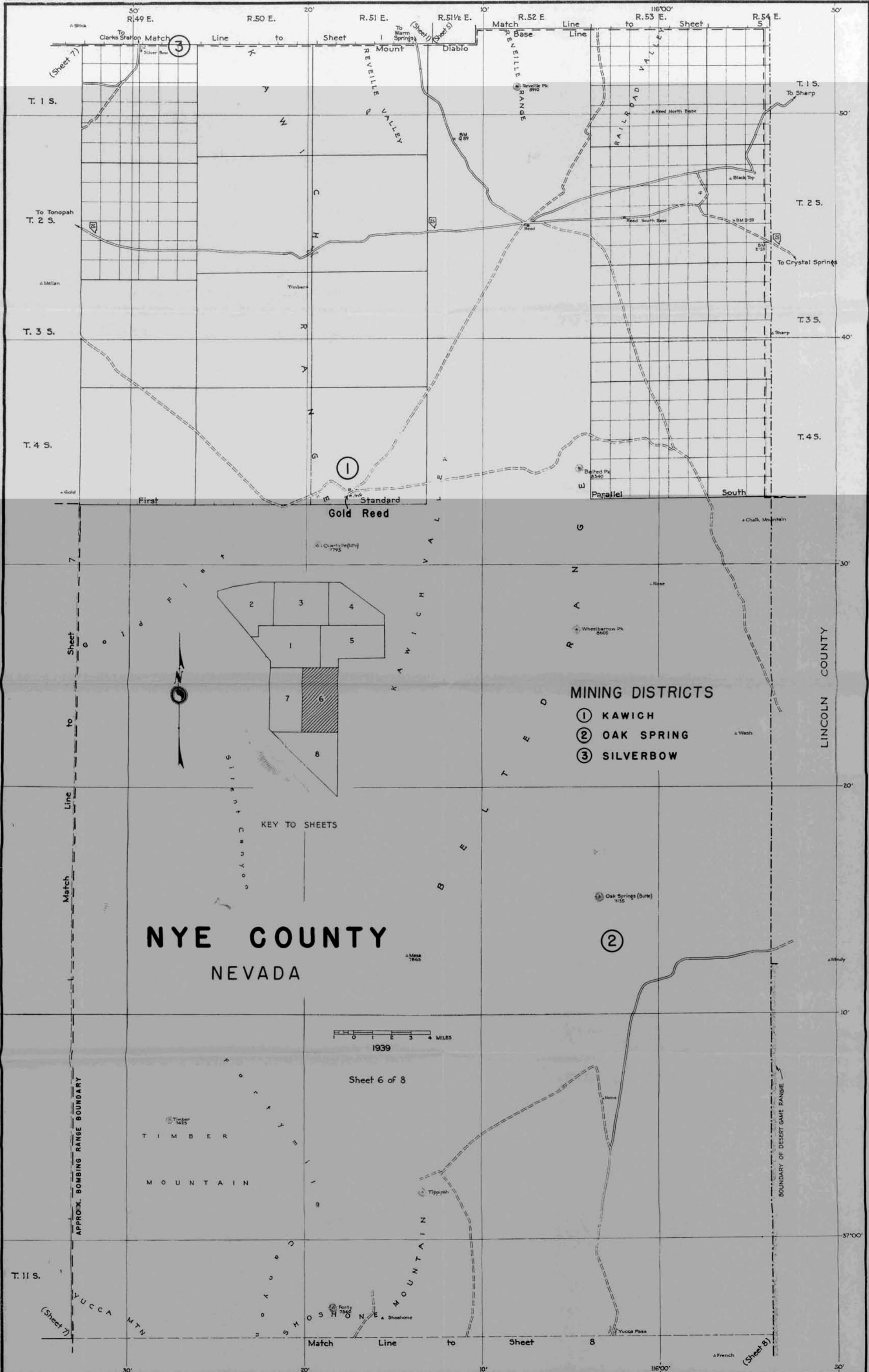
To Nyala

To Ploche



- MINING DISTRICTS**
- ① ARROWHEAD
 - ② REVILLE
 - ③ TROY
 - ④ WILLOW CREEK

NYE COUNTY
NEVADA



MINING DISTRICTS

- ① KAWICH
- ② OAK SPRING
- ③ SILVERBOW

NYE COUNTY
NEVADA

1939
MILES

Sheet 6 of 8

TIMBER
MOUNTAIN

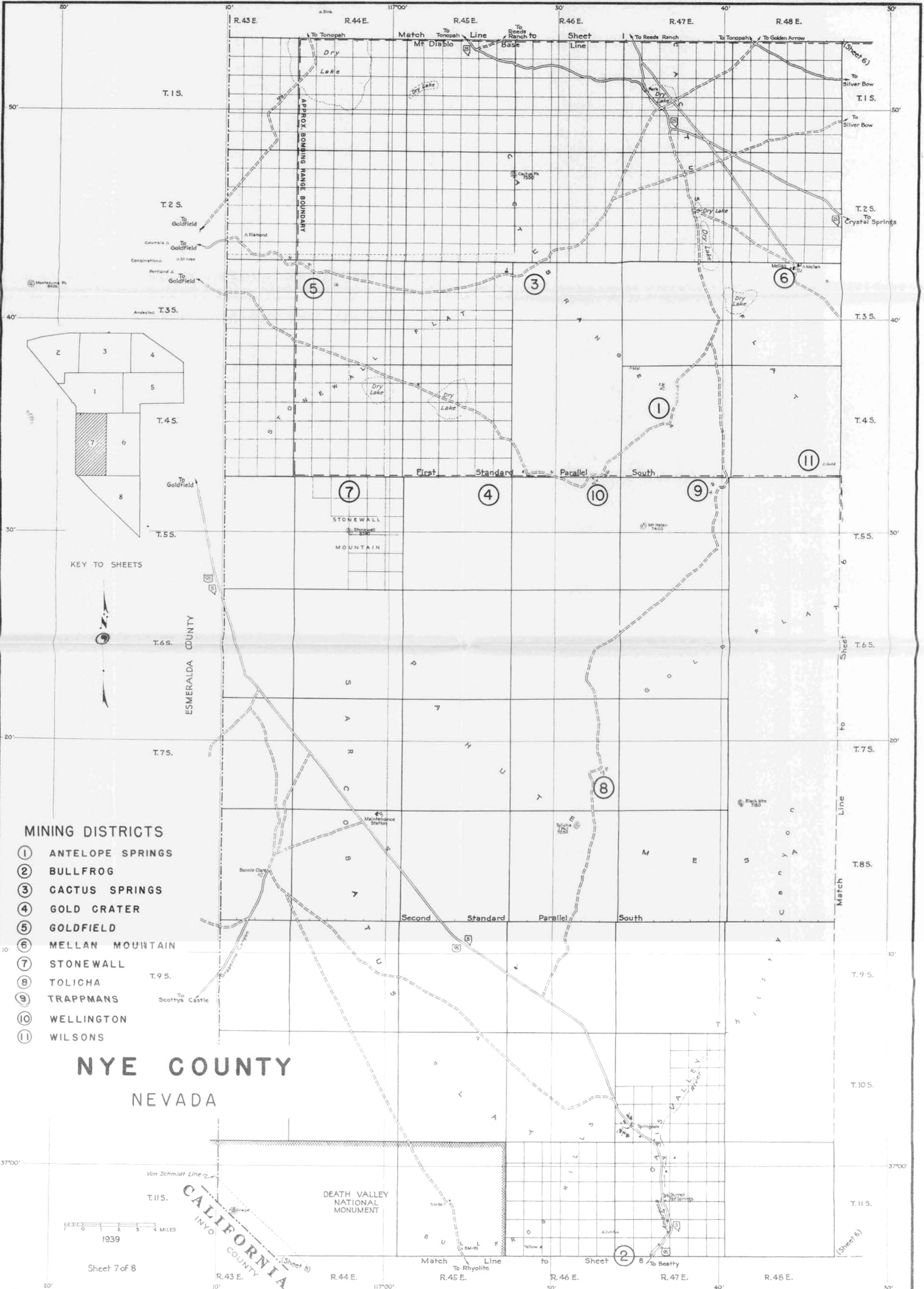
MOUNTAIN

APPROX. BOMBING RANGE BOUNDARY

BOUNDARY OF DESERT GAME RANGE

YUCCA MTN

(Sheet 8)



MINING DISTRICTS

- ① ANTELOPE SPRINGS
- ② BULLFROG
- ③ CACTUS SPRINGS
- ④ GOLD CRATER
- ⑤ GOLDFIELD
- ⑥ MELLAN MOUNTAIN
- ⑦ STONEWALL
- ⑧ TOLICHA
- ⑨ TRAPPMANS
- ⑩ WELLINGTON
- ⑪ WILSONS

**NYE COUNTY
NEVADA**

1939

Sheet 7 of 8

CALIFORNIA
COUNTY
INYO

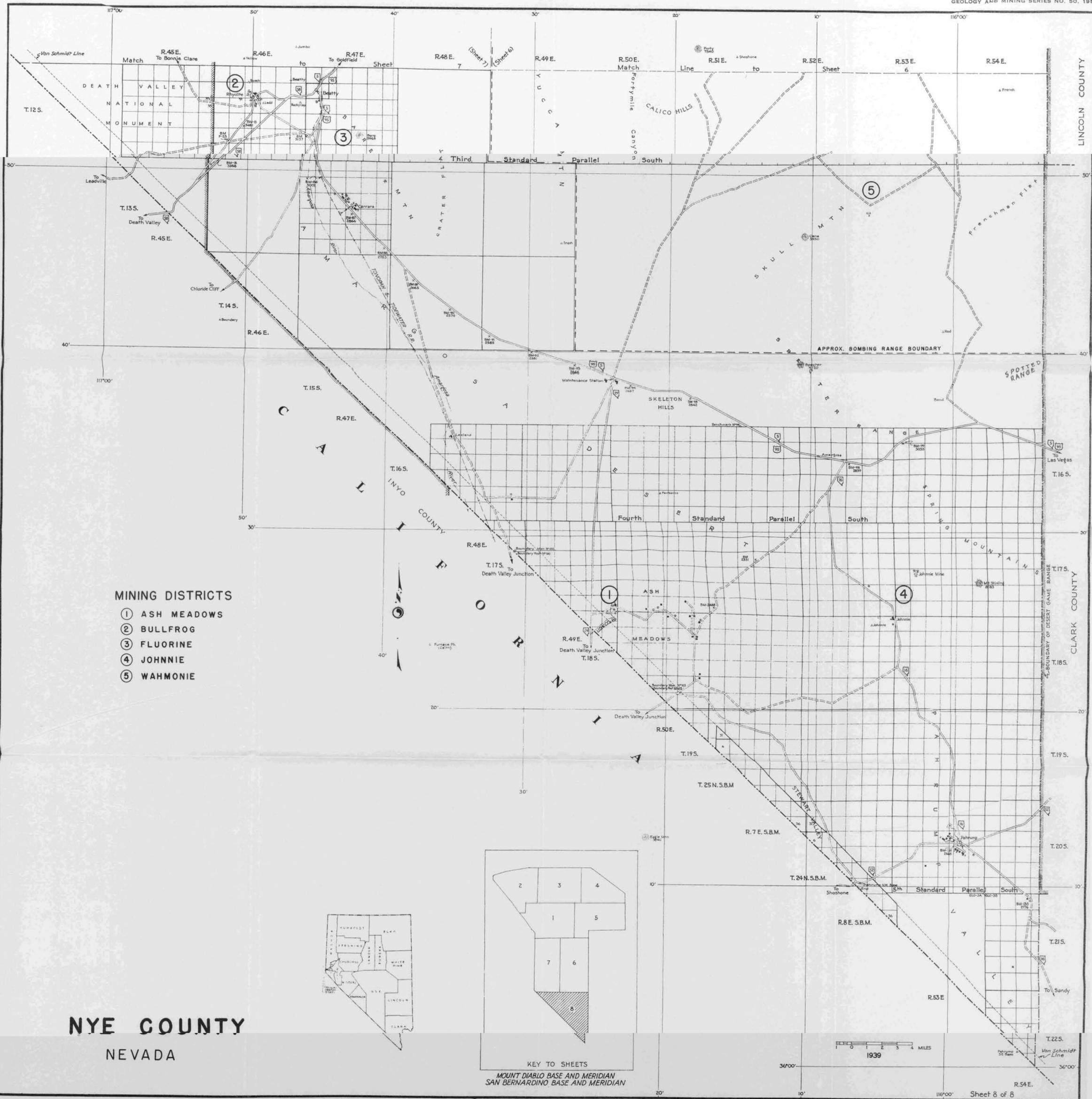
DEATH VALLEY
NATIONAL
MONUMENT

(Sheet 6)

Sheet 6

(Sheet 2)

Sheet 6



NYE COUNTY
NEVADA