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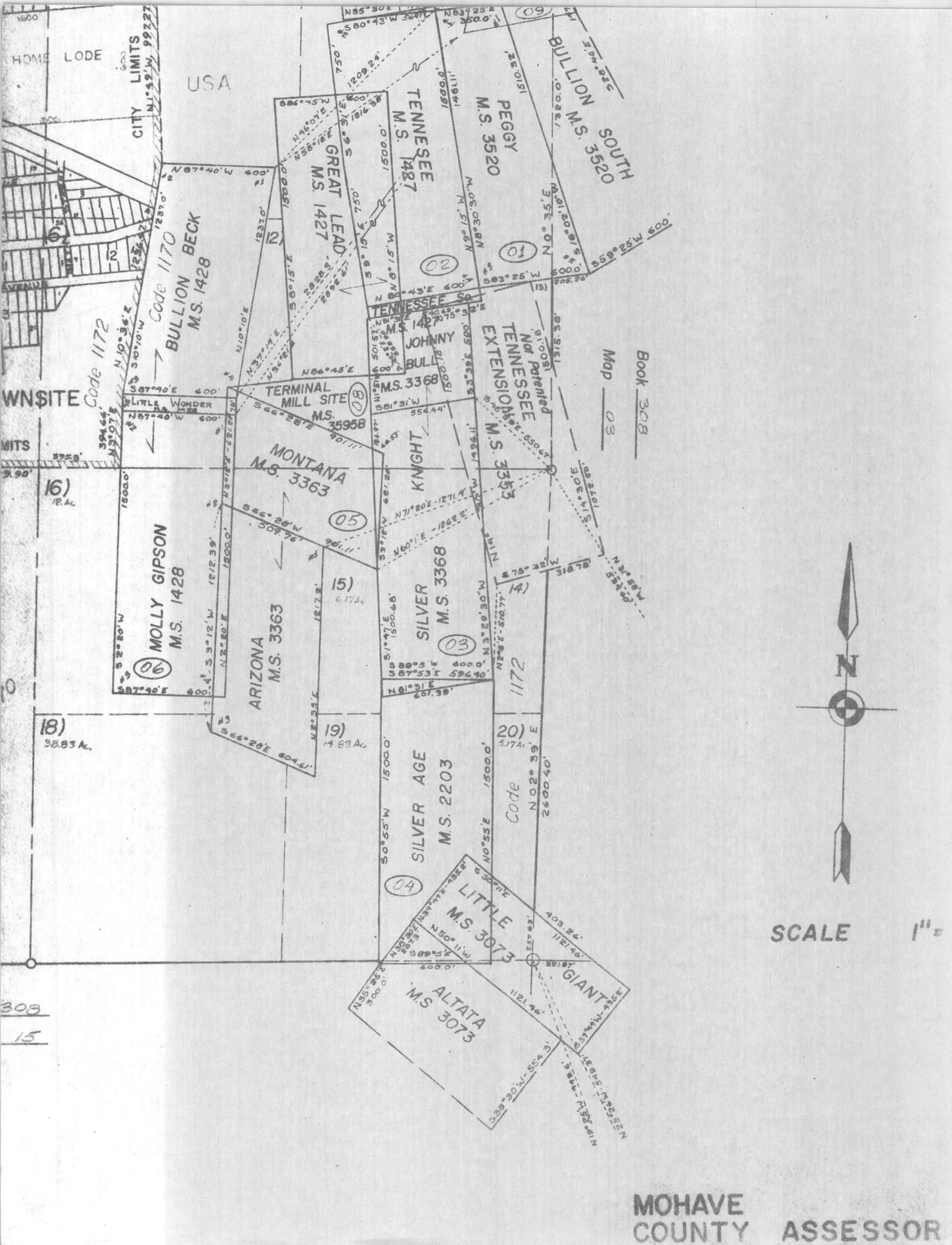

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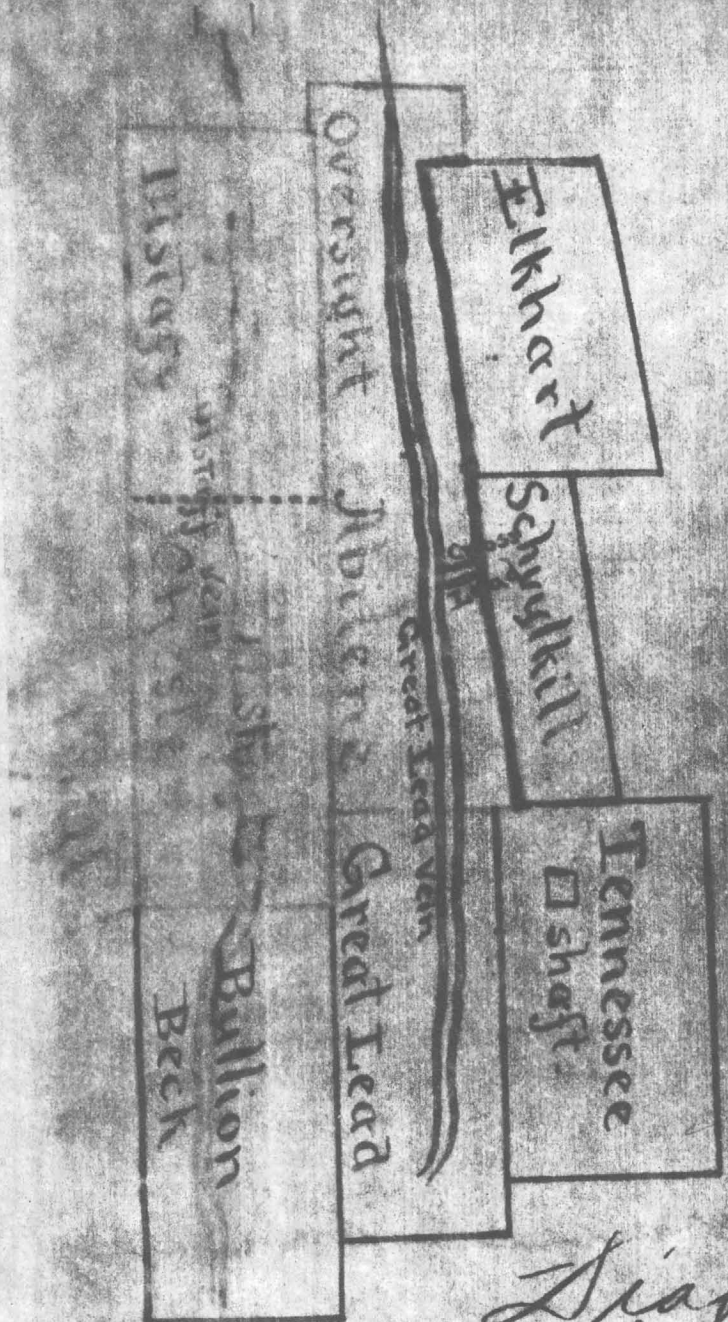

Diagram - Showing some of the most prominent mines of the camp. ——

Distaff Chronicle Mines mined

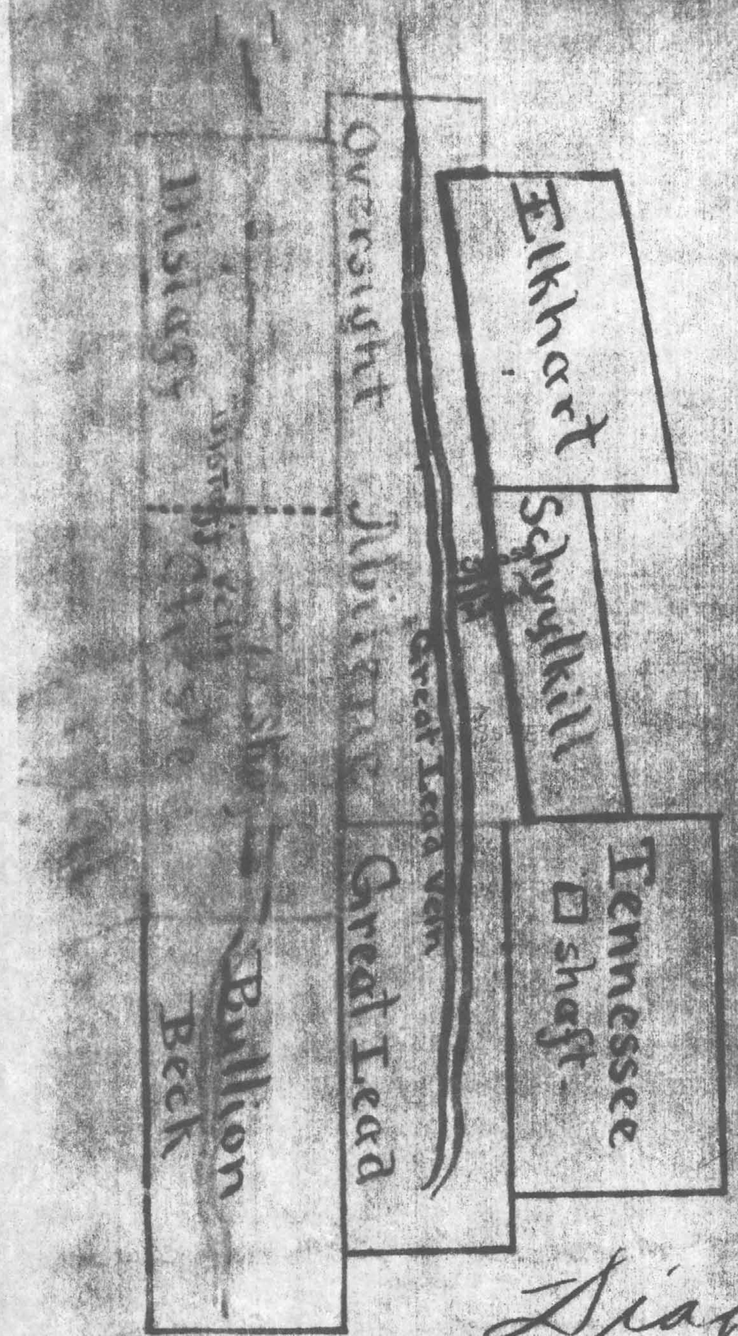

Diagram showing some of the most prominent mines of the camp. Distaff Chloride Mines in red

Mohave Co.
Chloride Dist.

TENNESSEE - SCHUYLKILL (file)

Located in Wallapai mining district, Sec. 3,T 23 N, R 18 W, and Sec. 34, T 24 N, R 18 W. Seven patented and three unpatented lode claims.

The Tennessee Mine is opened by two shafts, the Tennessee shaft and the Schuylkill shaft. The Tennessee shaft is vertical and is 1400 feet in depth. The Schuylkill shaft is an incline of about 80° and is 800 feet deep. Both shafts are in the footwall of the vein.

The Tennessee mine is said to have been discovered in 1894 by A. M. MacDuffee, and operated intermittently by MacDuffee and other operators up to 1912. Lead was the chief product of these operations; the zinc being left in the stopes where possible. In 1913 the Needles Mining and Smelting Company, a subsidiary of the United States Smelting, Refining and Mining Company, obtained a lease on the property and after putting down the present shaft to a depth of 1400 feet, operated it continuously until 1917. A jig-mill concentrate was shipped to a smelter erected at Needles, California.

After this period the mine remained inactive until 1928 when the Monark Lead Company brought the Tennessee and the Schuylkill mine to the north under one management. A 150 ton flotation mill was erected at this time but did not operate because of the low base metal prices prevailing after the 1929 collapse.

Early in 1936 the Tennessee-Schuylkill Corporation was formed, the mine unwatered and cleaned out, and production started toward the end of 1936. There followed a period of large production, 1937 showing the greatest production of any year of operation. It was during this time that most of the Schuylkill ore body was mined above the 900 level and parts of the Tennessee chute adjoining the old workings of the Needles Smelting and Refining Company. The operators were just starting to mine the high grade zinc ore above the 1000 level when low base metal prices at the beginning of the year 1939 forced the mine to close.

These prices did not rise until nearly the end of the year, and the mine was reopened in November, 1939. The 1000 level stopes were opened up again and the 1200 level was driven northerly on the vein. While the showing below the 1000 stopes was disappointing they continued the 1200 drift and soon came into very good ore which developed into the 1228 stope and those above and below.

On the strength of this showing it was decided to drive the 1170 level farther north. This resulted in the finding of an entirely new ore body, the 1170 NC. Up until this time it was thought that the Tennessee north ore shoot stopped at a fault striking nearly normal to the vein and dipping about 55° to the north. This was the first instance where ore occurred in the hanging wall of this fault.

At about this time the 1250 winze was sunk to the 1350 level to develop the ore mined in 1328 stope.

Shortly after this, in February, 1942, it was decided to prospect the Tennessee vein south of the Tennessee shaft. After a diamond drilling campaign, sufficient evidence was obtained to warrant a crosscut to the vein due east of the shaft. This crosscut was driven and the 900 south orebody opened up. The ore in this shoot has proved to be lower grade than that in the north end of the mine, with gold and silver values especially low. The vein, however, is wide and has produced substantial tonnage of a good grade of lead-zinc ore.

The Tennessee vein is a true fissure vein striking about N 70° W and dipping about 85° to the east. Signs of considerable movement are shown in the vein in the presence of heavy gouge and often the walls show strong slickensides. The vein consists of galena and sphalerite containing small amounts of gold and silver, as the ore minerals, with a gangue of quartz, pyrite, calcite and highly altered wall work. In the Schuylkill ore shoot the pyrite contains the gold values which are higher in this part of the mine.

In contrast to the vein the walls are generally hard and stand well, consisting of a pre-Cambrian amphibolite, granite, gneiss and schist or a later granitic porphyry. The character of the wall rock appears to have no influence on the vein.

971
× 40
38840

1799
704
71996
123930
1266496
138840
1305336

OTHER MINES AND PROSPECTS ON THE TENNESSEE VEIN

The Elkhart mine, at the extreme north end of the Tennessee vein, is an old mine that has been idle for many years. The total production from this mine from 1901 through 1948, as shown in table 2, has been small. The mine workings, now inaccessible, are reported to consist of three shafts, six levels (the lowest 500 feet deep), drifts totaling about 2,600 feet, numerous stopes, and several crosscuts.

The Silver Age mine, near the extreme south end of the vein, was primarily a silver mine (table 2). The silver was probably derived in large part from silver chloride (cerargyrite) found in the oxidized zone. Accurate data concerning the inaccessible mine workings could not be obtained. It is reported that the shaft is about 150 to 200 feet deep and that drifts and stopes extend northward from the shaft for some 200 or 300 feet. The vein material on the mine dump is partly oxidized, chiefly to iron hydroxides. Pyrite is the most abundant primary sulfide. Minor amounts of galena and sphalerite, together with sparse chalcopyrite, are associated with the pyrite in quartz gangue.

Several shafts have been driven and numerous pits and trenches have been dug along the Tennessee vein from the Silver Age shaft to the Tennessee shaft. The deepest of these is the Johnny Bull shaft (pl. 18), which is reported to be 88 feet deep. No drifting or stoping from this shaft is known.

Diamond drilling on the southern part of the Tennessee vein was carried out by the United States Bureau of Mines (Tainter, 1947) during the period from September 16 to December 8, 1943. The exploratory work consisted of eight drill holes on the Johnny Bull and Silver Knight claims, between 750 and 2,450 feet south of the Tennessee shaft. The holes were distributed along the vein at intervals ranging from 200 to about 375 feet. All holes were drilled from the surface and inclined toward the vein. Four were drilled from the west side of the vein outcroppings and the other four from the east side. Depths below the surface at which the vein was intersected ranged from about 100 to 350 feet, the deepest corresponding approximately in altitude to the 400-foot level in the Tennessee mine.

All holes intersected the vein, but the vein filling in seven of the eight cores was barren of ore minerals or was so low in grade as to be of little or no economic interest. The only hole that showed a substantial amount of the ore minerals was hole 8, located about 1,900 feet south of the Tennessee shaft. This hole intersected the vein about 100 feet below the surface, at an approximate altitude of 4,100 feet. A 3.5-foot interval of sphalerite, galena, and pyrite in quartz gangue assayed 7.6 percent zinc, 0.1 percent lead, and 0.03 percent copper.

This intersection might suggest that the top of an ore body was penetrated, but the Bureau of Mines engineers believed that the extensive drilling necessary to determine the existence of an ore shoot in the vicinity of hole 8 was not warranted.

TURQUOISE MINES

Deposits of turquoise are restricted to the Ithaca Peak granite and occur most abundantly in the southern half of the main intrusive body south of Mineral Park, particularly on Ithaca and Turquoise Peaks. Many small and shallow workings have explored these deposits, and only the larger ones are shown on plate 18. Some of the diggings are very old, having been started by the Aztec Indians. Very little work has been done on the deposits for many years.

Turquoise occurs typically in veinlets and small lenses in silicified, sericitized, and kaolinized porphyritic granite. Turquoise most commonly fills cavities in quartz veinlets, although some is in altered granite. Other minerals sparsely associated with turquoise in a few places are malachite, chrysocolla, and hydrous iron oxides. Sterrett (1908, pp. 847–852) describes some of the individual deposits in this area.

The features of the deposits suggest a secondary origin by supergene processes similar to those given by Paige (1912) for the origin of turquoise in the Burro Mountains of New Mexico.

LIST OF REFERENCES

The literature pertaining to the district is not extensive. The list given below includes the chief publications. Of these, Schrader's report on districts in Mohave County furnishes the most extensive description of the Wallapai district, and it is of particular value in furnishing descriptions of many of the mines. Thomas' manuscript contributes much information, particularly his detailed descriptions of the minerals and their paragenetic relationships. He includes a small-scale geologic map that covers an area extending from Mineral Park northwestward for several miles beyond Chloride. Most of the references are brief summaries of the geology and ore deposits, probably taken in part from Schrader's previous work.

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Garrett, S. K., 1938, Tennessee-Schuylkill mine: Ariz. Bur. Mines Bull. 145, pp. 117–119.

The Payroll vein strikes N. 30°–35° W. and dips steeply to the northeast. It commonly ranges in thickness from about 4 to 12 feet, though Schrader (1909, p. 62) reports a maximum thickness of nearly 100 feet. The vein can be traced by persistent croppings southeastward to a point about 1,000 feet beyond the Mary Bell mine, but past this point it is poorly exposed and correlations are somewhat questionable. The total length of the vein is about 6,700 feet. Northwest of the main shaft of the Payroll mine the vein has been offset by a fault. (See p. 138.)

The vein filling, as determined chiefly from material on the mine dump, is sphalerite, galena, pyrite, and chalcopyrite in a gangue of quartz. Cerussite, although not observed, has been reported as occurring in moderate amounts in the oxidized parts of the vein.

TENNESSEE-SCHUYLKILL MINE

The Tennessee-Schuylkill mine is 1 mile east of Chloride at the western foot of the Cerbat Mountains, at an altitude of about 4,200 feet. It is an old mine and has been worked intermittently by numerous operators for at least the past 50 to 60 years. During most of World War II the mine was operated by the Tennessee-Schuylkill Corp., and it was the only large mining operation in progress in the district. A mill located near the Tennessee shaft was running at a capacity of about 150 tons of crude ore per day, averaging 6 to 8 percent zinc, 3.5 percent lead, and 17 to 25 ounces of silver per ton.

The mine has been the largest producer of lead and zinc in the district (table 2). It has produced almost as much lead as zinc and, in addition, has yielded substantial values in gold and silver. This and the Golconda are the only two mines that have yielded a total production valued in excess of $1,000,000.

The Tennessee-Schuylkill mine is on the northern part of the Tennessee vein (pl. 18). The main, or Tennessee, shaft is about 1,400 feet deep. The Schuylkill shaft, about 1,450 feet to the north, is about 800 feet deep but is caved, so that the only access to the mine is by the Tennessee shaft. For many years the Schuylkill and Tennessee mines were operated as separate mines. Plate 19 is a longitudinal section along the vein showing the extent of the workings. The section has been compiled from data of various sources and may be inaccurate in part because past records are scanty and underground workings are inaccessible in most of the Schuylkill workings and also in a very large part of the Tennessee workings. It will be noted that only a small amount of stoping and drifting has been done below the 1,400-foot level. Also, very little work has been done south of the Tennessee shaft, although most of the work in progress when the mine was visited in 1943 was confined to stopes off the 900-foot level south of the shaft.

The Tennessee vein is about 6,000 feet long and strikes N. 8° W. Dips are steep, averaging 85° E. in the Tennessee and Schuylkill workings. One reversal of dip, 50 feet north of the Tennessee shaft between the 900- and 1,250-foot levels, is to 87° W. Garrett (1938, p. 118) notes that ore shoots in the mine tend to occur where the vein changes to a more westerly strike. In common with many other veins in the district, the Tennessee vein shows considerable pinching and swelling along both strike and dip. In the Tennessee workings thicknesses range from 1 to 22 feet; the average is about 8 feet. Spurs, irregular branches, and small parallel veins are characteristic. In a few places enrichment is found at the junction of branch and spur veins with the main vein. Other junctions show lower-grade ore than average.

Gouge, locally accompanied by brecciated vein material, is common along the hanging wall and footwall of the vein as well as irregularly traversing the vein. Alteration of the wall rock, with the formation of sericite and pyrite, extends a few inches to several feet from the vein. The composition of the wall rock has not influenced the vein as regards either width or mineral composition. Throughout the entire length of the vein the country rock is a complex of amphibolite, pegmatite, granite, gneiss, and schist.

The hypogene metallic minerals are chiefly sphalerite, galena, and pyrite with minor amounts of arsenopyrite and chalcopyrite. They commonly occur intimately associated in a gangue of milky quartz. In a few places a crude compositional banding of moderately pure sphalerite, galena, or pyrite is present, the bands seldom exceeding a few inches in width.

Supergene minerals are anglesite, cerussite, cerargyrite, native gold, and—rarely—native silver. The supergene ores are now of little importance, although the precious metals were of chief interest in the earlier period of mining in the higher oxidized zone.

Plate 19 indicates that those ore shoots about which information was obtainable pitch to the north. The ore shoots likewise show an increase of sphalerite over galena southward. The ore shoot south of the Schuylkill shaft has a stope length of about 400 feet along the 800-foot level (pl. 19) and a pitch length of about 1,000 feet between the 300- and 1,000-foot levels. An even larger ore shoot has probably been mined out in the ground a few hundred feet north of the Tennessee shaft, but no records of it are available and the workings are largely inaccessible. The four main ore shoots were projected to the surface, and an attempt was made to determine any special characteristics of outcrops at these places that might aid in predicting ore shoots in the southern part of the vein. However, no special thickness, gossan, brecciation, or other indications of possible ore shoots were evident.

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DESCRIPTIONS OF MINES AND PROSPECTS

Several inherent difficulties were encountered in attempting to obtain data on the many mines in the district. Most of the mines were worked for the high-grade silver or gold in the shallow oxidized parts of the veins. Operations generally ceased when the lower-grade primary sulfides were reached. The principal work in most of the mines was done many years ago, and most of them are now largely or entirely inaccessible owing to caving or flooding. A few mines are partly accessible, but generally such a small part of the mine workings is disclosed, commonly in the oxidized zone or unproductive parts of the drifts and crosscuts, that it is not possible to obtain much tangible information concerning ore bodies or reserves. Mine maps and records are generally lacking, and many of those available are of such character as to make their reliability very dubious. Even past records of such large-scale operations as the Tennessee-Schuylkill and Golconda mines leave very much to be desired.

During Schrader's (1909, pp. 54–118) visit to the district in 1907, most of the workings were accessible and information was relatively fresh in the minds of people consulted, so that his data on most of the mines still remain by far the most reliable source of published information even though considerable additional work has probably been done in many of them. Bastin (1924) describes a few mines in some detail, whereas the only mine Thomas (1949, pp. 700–703) describes in any detail is the Emerald Isle mine. Garrett (1938, pp. 117–119) has described the Tennessee-Schuylkill mine, and during August and September 1943 engineers of the United States Bureau of Mines obtained assay data (Haury, 1947) on about 30 mines in the district from records and from a sampling of mine dumps and parts of all the accessible mines.

A few of the mines for which worthwhile new data have been assembled, in addition to material previously published, are described on the following pages. Most of these are mines that have been the leading producers of lead and zinc (table 2), although some, such as the Aurora and Emerald Isle mines and the Gross prospects, are briefly described because they contain minerals not commonly found in the district.

AURORA MINE

The Aurora mine is about a mile east-southeast of Chloride. The property consists of one unpatented claim (Aurora) leased by E. E. Vondriska from J. G. Blackwell, of Chloride. The mine was formerly worked on a small scale primarily for lead and silver in the oxidized zone, but it was being worked in 1943 for vanadium and lead. No ore had been shipped by Vondriska, but about 5 tons of vanadinite and 5 tons of lead ore were piled near the portal. The main workings consisted of a drift about 300 feet long bearing south along the vein. About 30 feet from the south end of the drift a winze 40 feet deep had been sunk on the vein.

The Aurora vein strikes north, is nearly vertical, and averages 4 feet in width. It can be traced southward from the mine for about 1,400 feet (pl. 18). About 275 feet south of the north end of the vein vanadinite crystals occur in open spaces in the wall rock of pre-Cambrian gneissoid granite along the west side of the vein. The crystal aggregates are erratically and sparingly exposed over an area about 15 feet long and 10 feet high. The vanadinite is associated with an iron-stained earthy material. This is the only occurrence of vanadinite observed or reported in the district.

CHAMPION MINE

The Champion mine is about a mile southwest of Cerbat camp on the western front of the range at an altitude of about 4,000 feet (pl. 18). This mine is reported to be one of the first discoveries in the district, worked in its early history chiefly for gold, silver, and lead. Table 2 shows that the mine has produced a substantial amount of zinc during its later operations. No reliable information could be obtained concerning the extent of the mine workings or the more recent operations. The mine was idle when visited, and all the workings were inaccessible.

The vein on which the mine is situated strikes about N. 50° W. and dips about 75° NE. It can be traced on the surface for a little more than 1,000 feet. A minette dike averaging about 6 feet in width lies alongside the southeastern part of the vein (pl. 18). Schrader (1909, p. 104, fig. 15) shows a section of the vein and dike sketched at the mine near the surface. Metallic sulfides observed on the mine dump include pyrite, galena, sphalerite, and a very minor amount of chalcopyrite; all are contained in quartz gangue.

EMERALD ISLE MINE

An unusual type of copper deposit is found at the Emerald Isle mine, located about a mile west of Mineral Park, Wash. The mine was idle when visited early in 1943 and again in 1950. It was worked at various times from 1917 to 1943, and late in 1943 the Emerald Isle Copper Co. resumed mining and began the erection of a 300-ton leaching plant, which was completed in 1944. Mining continued until June 1946. In 1947 the Lewin-Mathes Co. started operations on the property and continued work until June 1948. About 55,000 tons of copper was recovered from the ores during the period 1943–48.

Mining in the early days was carried on chiefly from underground workings, although work since 1943 has been done almost entirely from an open pit. The underground workings were inaccessible when visited. Two short shafts were sunk, and according to reports the main shaft is 90 feet deep, penetrating 80 feet of gravels and boulders and, at the bottom, 10 feet of bedrock. In the gravels near the bottom of the shaft a drift extends northeastward for about 300 feet, and another drift extends southwestward for about 1,100 feet. Until 1943 most of the surface work had been done in a small pit about 400 feet east of the main shaft. When visited in 1950, the open-cut work had been extended westward to the upper part of the old underground workings northeast of the main shaft.

The deposit consists of a fissure vein and an irregular area of mineralized alluvium bordering the vein chiefly on the east. The mineralization consists of bluish-green chrysocolla and shiny black copper pitch (probably an impure copper silicate).

The large open pit, which to date has yielded most of the copper ore, furnishes good exposures of the chrysocolla-bearing alluvium and also the upper part of the fissure vein. The mineralized alluvium consists of copper pitch and chrysocolla coating particles and filling interstices in the various-sized outwash material of the valley. Except for a few mineralized fissures, striking northeast, and the vein near the shaft, the walls of the open pit show the individual copper-bearing bodies as concentrations of the chrysocolla and copper-pitch cement in irregular lenses and pods ranging from a few inches to several feet across. The outlines of a few of the lenses are clearly controlled by the bedding of the debris. Boundaries of the mineralized parts are commonly sharp. In places the finer-grained gravels and grits are uniformly dull green, which may in part be due to material other than copper. The richer parts are the typical bluish green of chrysocolla.

The gangue consists of alluvial material ranging from sand and grit to boulders as much as 4 feet long. The debris is commonly subangular to angular and composed of rocks from the pre-Cambrian crystalline complex as well as from the Mesozoic (?) granite. Granites of various types predominate to a great extent, although a minor amount of volcanic material is present. The material in the pit is fairly well cemented.

The upper part of the vein is exposed on the west side of the open pit. Here it is several feet wide and cuts the mineralized alluvium. The vein strikes about N. 30° E. and is vertical. The minerals are the same in the vein as in the open pit, but in richer concentrations. The vein walls are irregular but distinct. Part of the vein is banded.

During Thomas' work in the district (1949, pp. 701–703) he was able to observe the underground relations of the vein to bedrock. These relations were of much importance to him in interpreting the origin of the deposit. He states:

> * * * In its uppermost portions the vein is vertical or dips steeply north, but dips of 45 degrees north have been reported in some of the lower workings. The vein ranges from 3 to 12 feet in width. Alluvium occupies both walls at and near the surface. At depths as little as 25 feet, however, bedrock occurs in the footwall, and alluvium occurs in the hanging wall. * * *
>
> Where bedrock was observed in the footwall the vein filling still consisted of cemented alluvial detritus. The nature of the vein where bedrock occurs in both walls is not known. Specimens of granite porphyry from the footwall are leached and thoroughly altered, and tiny irregular veinlets of chrysocolla occur in the rock. In thin section the principal minerals are seen to be abundant clay mineral, sericite, and brown chlorite.

The age of the deposit is Quaternary, because the mineralization passes into and is contained chiefly in alluvium that is assigned to the Quaternary. Thomas (1949, pp. 702–703), who believes that the chrysocolla is of primary rather than secondary origin, gives his reasons as follows:

> It has been suggested that the mineralization was by solutions derived from the weathering of the "porphyry copper" deposit of the Mineral Park district. This would involve gravitative transfer of the solutions and localized deposition of chrysocolla around and within a strong fissure vein and associated fractures. Such solutions could exist, but the concentration of copper in them would be negligible, and there are no plausible reasons to explain the concentration and deposition of the copper at this particular location and within a vein.
>
> On the other hand, solutions ascending along fissures and spreading out into the alluvium provide a simple and logical source for the copper. Assuming this to have happened, the question arises as to the nature of the chrysocolla. This mineral is usually supergene and is a secondary product of various primary copper-bearing minerals. In the Emerald Isle deposit, however, the following points suggest that the chrysocolla is primary:
>
> (1) There are no relict grains of sulfides, or any minerals, which might have served as a primary source of the copper. It might be assumed that replacement or solution of such primary minerals was complete, but at least a few specks should have been preserved here and there.
>
> (2) The texture of the chrysocolla, both in vein and blanket, is delicately banded and crustified, which suggests that formation was by open space filling and not replacement. If the chrysocolla is supergene the logical source of the copper would be at some higher level. If there were primary mineralization above, however, furnishing the source of copper solutions, there should have been primary mineralization at the present levels, at least in the vein. This would have to be leached completely away, before the solution of overlying material, in order to explain the lack of relict primary minerals and replacement textures. Such a sequence does not seem feasible.
>
> (3) Some of the veinlets pinch out upward. The chrysocolla filling apparently was deposited by ascending solutions. Perhaps the veinlets could be explained by lateral secretion, but the primary source material would still be missing.

954714—51——3

roughly the same distance northwest and southeast of the shaft. The 600-foot level, however, extends northwestward from the main shaft along the vein, intersecting the surface at a point about 2,400 feet beyond the shaft. Southeast of the shaft this level is reported to extend for 400 feet. No drifts are reported between the 1,200-foot level and the bottom of the shaft (1,400-foot level).

The Golconda vein strikes northwest and dips to the northeast (pl. 18). The angle of dip varies, but it is reported to average about 65° in the underground workings. The vein pinches and swells, ranging in thickness from 2 to 7 feet. On the surface the vein can be traced, chiefly by small prospect pits, for about 4,000 feet. Near its northwest end it splits into several branches, two of which form approximately parallel prongs and have opposing dips. The Oro Plata mine is located on the southwest prong. A branch, about 1,700 feet long, trending in a more northerly direction, is known as the Primrose vein.

The country rock is chiefly the pre-Cambrian complex, mostly granite. Numerous small, irregular bodies of the Ithaca Peak granite, too small to be shown on the geologic map, are exposed on the surface in the area along and adjacent to the trend of the vein.

The principal metallic minerals, as determined chiefly from material on the mine dumps, are sphalerite, galena, pyrite, and chalcopyrite, contained in a milky quartz gangue. Much of the sphalerite is dark brown to almost black. Sphalerite is greatly in excess of galena. This is in marked contrast to the Tennessee-Schuylkill mine, which has produced about the same amount of zinc as the Golconda mine (table 2) yet has produced almost as much lead as zinc.

Information of a general nature indicates that the best ore shoots on the Golconda vein were found northward from the main shaft for about 1,000 feet. Most of the ore has been removed from the surface to the 600-foot level. Reports vary greatly regarding the grade and quantity of ore left in the workings below the 1,000-foot level.

About 500 feet southeast of the shaft on the 700-foot level a crosscut to the southwest connects with the mine workings along the Tubb, or Middle Golconda, vein. One of the higher levels in the Golconda mine also is reported to be connected by a crosscut to the Tubb vein. The Tubb vein roughly parallels the Golconda vein and, like it, dips to the northeast. On the surface the Tubb vein is 350 to 600 feet distant from the Golconda vein. Four levels, with a total of about 3,500 feet of drifts, are reported on the Tubb vein.

GROSS COPPER PROSPECTS

A low-grade deposit of chalcocite occurs on the Gross ranch near the western border of the main exposure of the Ithaca Peak granite

south of Mineral Park. The inaccessible mine workings are reported to consist of a 200-foot shaft and two drifts, each about 600 feet long. One drift is to the east, and the other is to the northeast. The workings were driven in 1926 by the C. and A. Mining Co. No ore has been shipped. Material on the mine dump shows malachite, azurite, and specks of chalcocite disseminated in minor quantities in pyritized and silicified granite. Several veinlets of chalcocite 0.05 to 0.2 inch thick were observed, and one such veinlet is reported to have been 2 inches thick. A few specks or paper-thin stringers of molybdenite also were seen. Native copper, occurring as small leaf forms, is reported to be present in minor quantities but was not observed during the visit to the prospect.

GROSS MOLYBDENITE PROSPECTS

In Bismark Canyon, 1,400 feet east of the Gross ranch house, two adits have been driven to explore a low-grade molybdenite deposit (pl. 18). The work was done about 1926 by the C. and A. Mining Co., but no ore has been shipped. The adit on the north side of the canyon bears almost due north for about 800 feet. Molybdenite occurs most commonly in specks and small stringers in quartz veinlets that cut the Ithaca Peak granite. The veinlets are 0.02 to 1.5 inches thick, but thicknesses of 0.5 inch or less predominate. Some molybdenite occurs in small disseminated specks in the granite or as paper-thin stringers with little or no quartz.

The adit on the south side of the wash is inaccessible but is reported to bear a little east of south. Near its south end a crosscut to the east encounters a rhyolite dike about 20 feet wide in nearby exposures. The material on the dump shows numerous narrow molybdenite-bearing quartz veinlets and stringers of pyrite cutting the rhyolite. The minerals extend into the granite in the same manner that was noted where they are exposed in the adit on the north side of the wash.

HIDDEN TREASURE MINE

The Hidden Treasure mine is nearly 2 miles southeast of Chloride on the lower western slope of the mountains (pl. 18). The property consists of five claims along and bordering the Hidden Treasure vein held by Frank H. Grannis, of Chloride. The mine has been worked intermittently for many years by numerous operators. Schrader (1909, p. 72) reports mining operations prior to his visit to the district in 1907. The mine has produced, in addition to gold, silver, and copper (table 2), a little more than 115 tons of metallic zinc and nearly 80 tons of metallic lead during the period of recorded production from 1901 to 1948.

954714—51——4

The mine workings, which were partly accessible when the mine was visited, include several shafts, three crosscutting adits bearing northeast, and three levels vertically spaced about 50 feet apart. Drifts total about 3,000 feet.

The Hidden Treasure vein, on which the mine is located, has an average strike of about N. 50° W. and dips steeply to the northeast. It is correlated with the vein on which the Emerson mine is located (pl. 18). The vein pinches and swells to thicknesses ranging from 0.5 to 15 feet. Many branches and spur veins are disclosed in the underground workings of the Hidden Treasure mine. Crosscuts indicate several thin veins, some of which are probably branches of the main vein, trending about parallel to it. These smaller veins or branches, with few exceptions, could not be traced on the surface.

The country rock is the pre-Cambrian complex of granite, gneiss, schist, and amphibolite. In numerous places the country rock adjoining the vein is greatly altered to sericite or impregnated with pyrite for distances ranging from a fraction of an inch to several feet. Locally seams or thin zones of gouge an inch or two thick border the quartz veins.

The metallic sulfides, which are in a quartz gangue, include pyrite, sphalerite, galena, and minor quantities of chalcopyrite. Ore shoots that were observed in the underground workings are generally small bodies only a few feet long and a foot or less thick consisting of an intimate mixture of the various metallic sulfides and little or no quartz.

KEYSTONE MINE

The Keystone mine is in Mineral Park at an altitude of about 4,375 feet. Schrader (1909, p. 82) states that it was located in 1870 and that its surface ores were very rich in gold and silver, by reason of which it became the first important producer in the district. The mine, consisting of three patented claims, has changed ownership many times and, when visited, was reported to be owned by the Beach Estate. It was then idle, and water filled the underground workings and the shaft to a depth of about 50 feet below the surface. Table 2 indicates that the greatest values have been in silver and gold, although the mine has also produced substantial amounts of copper, lead, and zinc.

The mine was developed by a shaft, reported to be about 400 feet deep, and four levels at 150, 200, 300, and 400 feet. Drifting on the 150-foot level is reported to have reached a distance of 850 feet northwest of the main shaft and 450 feet southeast of it. On the 300-foot level drifts extend about 275 feet both northwest and southeast of the shaft. On the 400-foot level is about 125 feet of drifting, mostly to the northwest. The greater part of the ore above the 300-foot level is reported to have been worked out.

The vein on which the mine is located strikes northwest and dips to the northeast at angles ranging from about 65° to 80°. About 800 feet northwest of the shaft the vein splits into two main branches; the southern branch dips prevailingly to the southwest at a steep angle and near its west end cuts a wide rhyolite dike. Another vein about parallel to the main vein is reported to lie approximately 100 feet northeast of the Keystone shaft, although no evidence could be found of this vein in surface outcroppings northwest of the shaft.

Vein matter on the mine dump is milky quartz with abundant pyrite and lesser amounts of sphalerite, chalcopyrite, and galena. Argentite, although reported to be present in the ore, was not found.

PAYROLL MINE

The Payroll mine is about 1.5 miles east of Chloride, near the head of Payroll Gulch, at an altitude of about 4,500 feet. The property, which includes the patented Payroll and Black Prince claims, is held by the Thomas B. Scott Estate. The property is an old one, having been located in 1887, and much of the early work consisted of shallow diggings along the Payroll vein chiefly for high-grade gold ore. Considerable mining had been done prior to Schrader's (1909, p. 62) visit to the district in 1907, as he reports three shafts, about 400 feet of drifts, over 600 feet of tunnels, and some crosscuts and stopes. The main shaft was 225 feet deep. The mine was idle and the workings were inaccessible when visited by the writer in 1943. The main shaft is now reported to be a little more than 600 feet deep. The mine was developed by four main levels, the 50-, 200-, 400-, and 600-foot levels. Drifting and stoping from these levels has extended chiefly southeastward along the vein, the maximum distance from the shaft being 500 feet on the 600-foot level. The total length of all drifts is reported to be about 2,000 feet.

Production from the mine during the period 1901–48, as given in table 2, shows that during these years the mine was essentially a producer of zinc, although the early, unrecorded production may have been mostly in gold and silver.

The country rock consists of many types of the pre-Cambrian complex, although light-gray, fine-grained granite, dark, medium-grained biotite granite, hornblende schist, and amphibolite predominate. A diabase dike, not shown on the geologic map, is poorly exposed for a short distance along the northeast side of the vein near the main shaft. It could not be found in its projected position on the northwest side of the gulch, and it apparently has been cut off by the northeastward-trending fault shown on plate 18.

OTHER MINES AND PROSPECTS ON THE TENNESSEE VEIN

The Elkhart mine, at the extreme north end of the Tennessee vein, is an old mine that has been idle for many years. The total production from this mine from 1901 through 1948, as shown in table 2, has been small. The mine workings, now inaccessible, are reported to consist of three shafts, six levels (the lowest 500 feet deep), drifts totaling about 2,600 feet, numerous stopes, and several crosscuts.

The Silver Age mine, near the extreme south end of the vein, was primarily a silver mine (table 2). The silver was probably derived in large part from silver chloride (cerargyrite) found in the oxidized zone. Accurate data concerning the inaccessible mine workings could not be obtained. It is reported that the shaft is about 150 to 200 feet deep and that drifts and stopes extend northward from the shaft for some 200 or 300 feet. The vein material on the mine dump is partly oxidized, chiefly to iron hydroxides. Pyrite is the most abundant primary sulfide. Minor amounts of galena and sphalerite, together with sparse chalcopyrite, are associated with the pyrite in quartz gangue.

Several shafts have been driven and numerous pits and trenches have been dug along the Tennessee vein from the Silver Age shaft to the Tennessee shaft. The deepest of these is the Johnny Bull shaft (pl. 18), which is reported to be 88 feet deep. No drifting or stoping from this shaft is known.

Diamond drilling on the southern part of the Tennessee vein was carried out by the United States Bureau of Mines (Tainter, 1947) during the period from September 16 to December 8, 1943. The exploratory work consisted of eight drill holes on the Johnny Bull and Silver Knight claims, between 750 and 2,450 feet south of the Tennessee shaft. The holes were distributed along the vein at intervals ranging from 200 to about 375 feet. All holes were drilled from the surface and inclined toward the vein. Four were drilled from the west side of the vein outcroppings and the other four from the east side. Depths below the surface at which the vein was intersected ranged from about 100 to 350 feet, the deepest corresponding approximately in altitude to the 400-foot level in the Tennessee mine.

All holes intersected the vein, but the vein filling in seven of the eight cores was barren of ore minerals or was so low in grade as to be of little or no economic interest. The only hole that showed a substantial amount of the ore minerals was hole 8, located about 1,900 feet south of the Tennessee shaft. This hole intersected the vein about 100 feet below the surface, at an approximate altitude of 4,100 feet. A 3.5-foot interval of sphalerite, galena, and pyrite in quartz gangue assayed 7.6 percent zinc, 0.1 percent lead, and 0.03 percent copper.

This intersection might suggest that the top of an ore body was penetrated, but the Bureau of Mines engineers believed that the extensive drilling necessary to determine the existence of an ore shoot in the vicinity of hole 8 was not warranted.

TURQUOISE MINES

Deposits of turquoise are restricted to the Ithaca Peak granite and occur most abundantly in the southern half of the main intrusive body south of Mineral Park, particularly on Ithaca and Turquoise Peaks. Many small and shallow workings have explored these deposits, and only the larger ones are shown on plate 18. Some of the diggings are very old, having been started by the Aztec Indians. Very little work has been done on the deposits for many years.

Turquoise occurs typically in veinlets and small lenses in silicified, sericitized, and kaolinized porphyritic granite. Turquoise most commonly fills cavities in quartz veinlets, although some is in altered granite. Other minerals sparsely associated with turquoise in a few places are malachite, chrysocolla, and hydrous iron oxides. Sterrett (1908, pp. 847–852) describes some of the individual deposits in this area.

The features of the deposits suggest a secondary origin by supergene processes similar to those given by Paige (1912) for the origin of turquoise in the Burro Mountains of New Mexico.

LIST OF REFERENCES

The literature pertaining to the district is not extensive. The list given below includes the chief publications. Of these, Schrader's report on districts in Mohave County furnishes the most extensive description of the Wallapai district, and it is of particular value in furnishing descriptions of many of the mines. Thomas' manuscript contributes much information, particularly his detailed descriptions of the minerals and their paragenetic relationships. He includes a small-scale geologic map that covers an area extending from Mineral Park northwestward for several miles beyond Chloride. Most of the references are brief summaries of the geology and ore deposits, probably taken in part from Schrader's previous work.

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DINGS, M. G., 1950, Wallapai mining district, Mohave County, Ariz.: Arizona Bur. Mines Bull. 156, pt. 1, pp. 138–142.

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GARRETT, S. K., 1938, Tennessee-Schuylkill mine: Ariz. Bur. Mines Bull. 145, pp. 117–119.

The Payroll vein strikes N. 30°–35° W. and dips steeply to the northeast. It commonly ranges in thickness from about 4 to 12 feet, though Schrader (1909, p. 62) reports a maximum thickness of nearly 100 feet. The vein can be traced by persistent croppings southeastward to a point about 1,000 feet beyond the Mary Bell mine, but past this point it is poorly exposed and correlations are somewhat questionable. The total length of the vein is about 6,700 feet. Northwest of the main shaft of the Payroll mine the vein has been offset by a fault. (See p. 138.)

The vein filling, as determined chiefly from material on the mine dump, is sphalerite, galena, pyrite, and chalcopyrite in a gangue of quartz. Cerussite, although not observed, has been reported as occurring in moderate amounts in the oxidized parts of the vein.

TENNESSEE-SCHUYLKILL MINE

The Tennessee-Schuylkill mine is 1 mile east of Chloride at the western foot of the Cerbat Mountains, at an altitude of about 4,200 feet. It is an old mine and has been worked intermittently by numerous operators for at least the past 50 to 60 years. During most of World War II the mine was operated by the Tennessee-Schuylkill Corp., and it was the only large mining operation in progress in the district. A mill located near the Tennessee shaft was running at a capacity of about 150 tons of crude ore per day, averaging 6 to 8 percent zinc, 3.5 percent lead, and 17 to 25 ounces of silver per ton.

The mine has been the largest producer of lead and zinc in the district (table 2). It has produced almost as much lead as zinc and, in addition, has yielded substantial values in gold and silver. This and the Golconda are the only two mines that have yielded a total production valued in excess of $1,000,000.

The Tennessee-Schuylkill mine is on the northern part of the Tennessee vein (pl. 18). The main, or Tennessee, shaft is about 1,400 feet deep. The Schuylkill shaft, about 1,450 feet to the north, is about 800 feet deep but is caved, so that the only access to the mine is by the Tennessee shaft. For many years the Schuylkill and Tennessee mines were operated as separate mines. Plate 19 is a longitudinal section along the vein showing the extent of the workings. The section has been compiled from data of various sources and may be inaccurate in part because past records are scanty and underground workings are inaccessible in most of the Schuylkill workings and also in a very large part of the Tennessee workings. It will be noted that only a small amount of stoping and drifting has been done below the 1,400-foot level. Also, very little work has been done south of the Tennessee shaft, although most of the work in progress when the mine was visited in 1943 was confined to stopes off the 900-foot level south of the shaft.

The Tennessee vein is about 6,000 feet long and strikes N. 8° W. Dips are steep, averaging 85° E. in the Tennessee and Schuylkill workings. One reversal of dip, 50 feet north of the Tennessee shaft between the 900- and 1,250-foot levels, is to 87° W. Garrett (1938, p. 118) notes that ore shoots in the mine tend to occur where the vein changes to a more westerly strike. In common with many other veins in the district, the Tennessee vein shows considerable pinching and swelling along both strike and dip. In the Tennessee workings thicknesses range from 1 to 22 feet; the average is about 8 feet. Spurs, irregular branches, and small parallel veins are characteristic. In a few places enrichment is found at the junction of branch and spur veins with the main vein. Other junctions show lower-grade ore than average.

Gouge, locally accompanied by brecciated vein material, is common along the hanging wall and footwall of the vein as well as irregularly traversing the vein. Alteration of the wall rock, with the formation of sericite and pyrite, extends a few inches to several feet from the vein. The composition of the wall rock has not influenced the vein as regards either width or mineral composition. Throughout the entire length of the vein the country rock is a complex of amphibolite, pegmatite, granite, gneiss, and schist.

The hypogene metallic minerals are chiefly sphalerite, galena, and pyrite with minor amounts of arsenopyrite and chalcopyrite. They commonly occur intimately associated in a gangue of milky quartz. In a few places a crude compositional banding of moderately pure sphalerite, galena, or pyrite is present, the bands seldom exceeding a few inches in width.

Supergene minerals are anglesite, cerussite, cerargyrite, native gold, and—rarely—native silver. The supergene ores are now of little importance, although the precious metals were of chief interest in the earlier period of mining in the higher oxidized zone.

Plate 19 indicates that those ore shoots about which information was obtainable pitch to the north. The ore shoots likewise show an increase of sphalerite over galena southward. The ore shoot south of the Schuylkill shaft has a stope length of about 400 feet along the 800-foot level (pl. 19) and a pitch length of about 1,000 feet between the 300- and 1,000-foot levels. An even larger ore shoot has probably been mined out in the ground a few hundred feet north of the Tennessee shaft, but no records of it are available and the workings are largely inaccessible. The four main ore shoots were projected to the surface, and an attempt was made to determine any special characteristics of outcrops at these places that might aid in predicting ore shoots in the southern part of the vein. However, no special thickness, gossan, brecciation, or other indications of possible ore shoots were evident.

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INDEX

U. S. GOVERNMENT PRINTING OFFICE: 1952

TENNESSEE MINE.

The Tennessee mine is 1 mile east of Chloride, at the foot of the mountains, on the east side of Tennessee Wash, at an elevation of about 4,050 feet. (See Pl. V, *B*.) It is owned by the Tennessee Mining Company, of Chloride.

The Tennessee is an old mine and has been worked for more than fifteen years. It has produced hundreds of thousands of dollars in ore. Among the earliest owners were A. M. MacDuffee, and later Mr. Botsford, who held the property for eight or nine years and is still part owner with the present company, which took it over in 1906. For the six years ending in 1903 the Hualpai Mining and Development Company, with headquarters at Los Angeles, operated the mine and took out chiefly lead ore. For a long time during this period the production was a carload of concentrates a day, or sometimes 50 carloads a month, besides a large amount of high-grade ore that was constantly being shipped. From 1904 to the middle of 1905 the mill was shut down, but since then the present company has been running the mine and mill almost steadily, and the property is now being developed for handling on a larger scale.

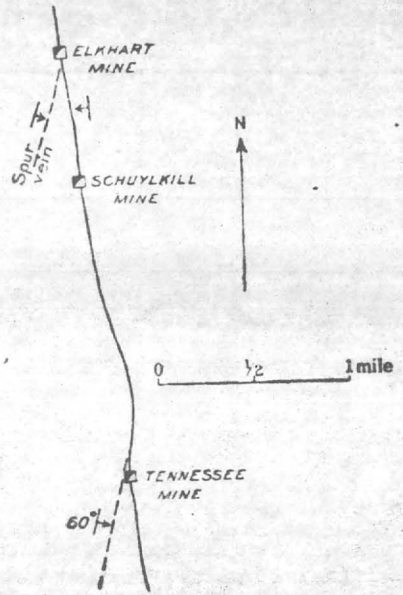
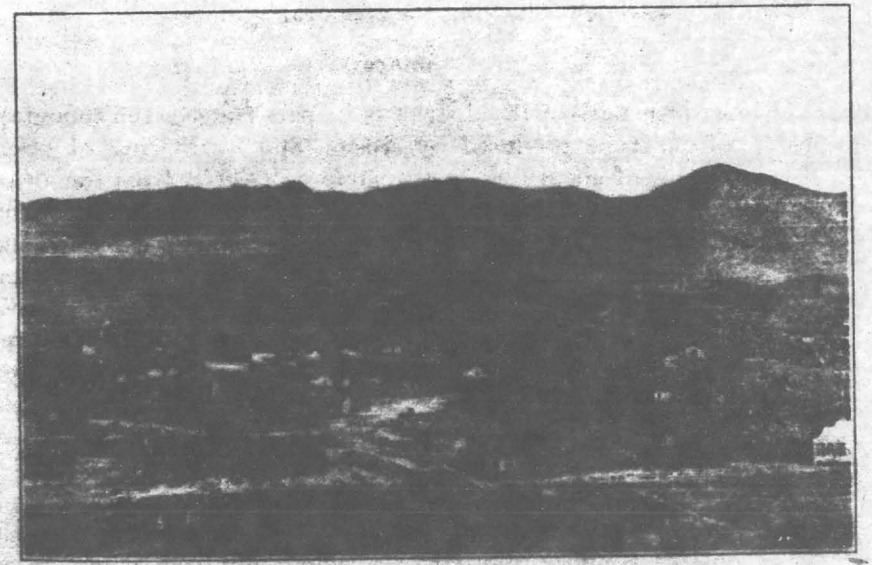


FIGURE 5.—Plan showing course of Tennessee vein.

The country rock at the mine is a gneiss with granite and schist occurring near by. The gneiss is composed chiefly of sericitized feldspar and crushed quartz with streaks of chlorite. The granite is a pinkish-gray medium-grained microcline rock, somewhat crushed, and contains very little biotite. The schist is the fine-grained, black, typical amphibolite variety and is composed essentially of brown hornblende, sharply defined feldspars, mostly triclinic, and a little pyroxene.

The mine is situated on the Tennessee vein (see fig. 5) and is developed by two inclined shafts and six levels. The shafts are located 280 feet apart. The main or northern shaft is 600 feet deep and the southern shaft 400 feet. The levels are spaced 100 feet apart vertically, the first level being 100 feet below the surface, as shown in the accompanying vertical section of underground workings

A. PART OF LAVA MESA SURROUNDING KINGMAN, LOOKING NORTHWEST FROM WEST SIDE OF TOWN.



B. CHLORIDE AND PART OF CERBAT RANGE, LOOKING EAST FROM SILVER HILL.

(fig. 6), which also shows the amount of drifting on the various levels.

The vein croppings, rising locally several feet above the surface, are reddish, brownish, yellowish, and blackish quartz and galena stained with iron and manganese. The vein is regarded as a part of the great lead-bearing "lode" on which the Schuylkill and Elkhart mines to the north are situated. At the surface the vein strikes N. 8° W. and dips about 68° E.

The main or north shaft starts on the vein, its slope at first coinciding with the dip of the vein. With increasing depth, however, the dip gradually diminishes until on the 400-foot level the vein lies 30 feet east of the shaft, and in the 200-foot drift on the 600-foot level the strike of the vein is N. 10° E. This change in strike, however, on this level may be occasioned by what seems to be a spur vein

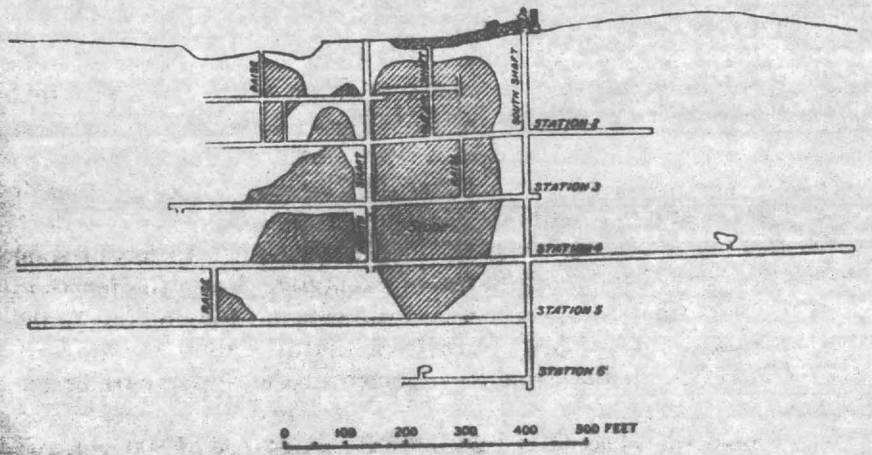


FIGURE 6.—Longitudinal section along Tennessee vein.

or feeder coming in from the west, as shown in figure 5, as there is a considerable body of rock, probably 5 or 6 feet in thickness, between the ore zone in the drift and that in the stope above, and as the structure in the crosscut from shaft to drift and main vein suggests the presence of such a spur vein which dips toward the main vein.

The walls for the most part are hard, smooth, and fairly regular. On the 600-foot level three systems of slickensides are shown, whose component direction indicates relative vein movement downward and northward at angles of about 40°. Slickensiding is also shown to a marked degree in some of the ore.

The Tennessee is a lead mine, and one of the most prominent lead-bearing properties of the Territory. The ore contains mainly galena, zinc blende, and pyrite, and also carries good silver values and some

gold and copper. Specimens collected from the 600-foot level consist of a medium to fine grained mixture of bright crystalline galena and dull resinous sphalerite in about equal amounts, and contain about 5 or 6 per cent of irregularly disseminated iron and copper pyrites. The galena locally exhibits an imperfectly banded structure, due to pressure.

The average run of mine ore, omitting the zinc, is about as follows: Lead, 20 to 70 per cent (concentrates, 75 per cent); silver, 8 ounces (concentrates, 25 ounces); gold, small amount; copper, some in deep part of mine, increasing in amount with depth.

Gold occurs only in small amount and is found in the pyrite. Of the total ore output about one-third is high-grade shipping ore; the remaining two-thirds is milled.

The mine has been productive from the surface down. From the ground between the surface and the 400-foot level thousands of tons of rich galena ore have been shipped to the smelter. The ore shoot had a horizontal extent of about 250 feet, and contained some bodies 15 feet in width. Extraction was easy with a small amount of timbering, but it is reported that owing to the extravagant management of the property the profits realized were small. There is said to be good ore still remaining in this part of the mine, but on account of caving of the stopes it will be difficult to extract.

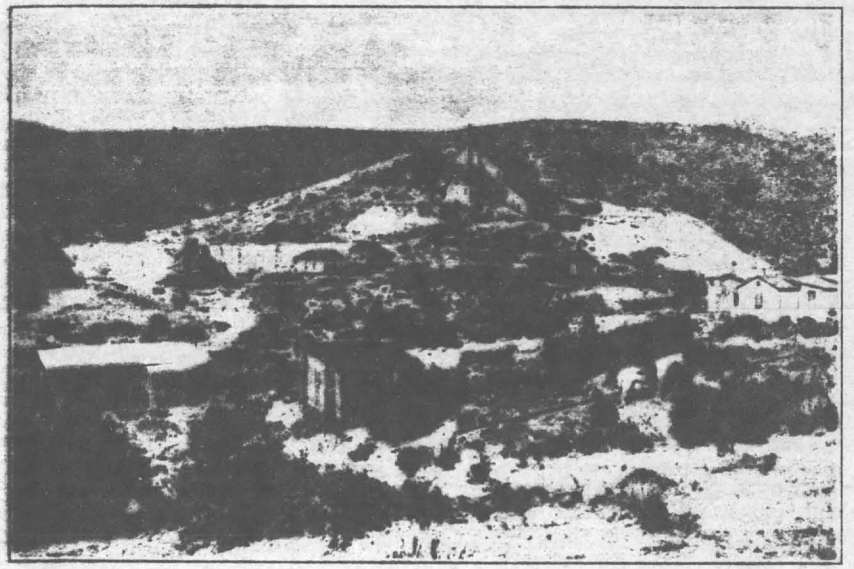
On the 400-foot level a vein 21 feet thick, with 5 inches of solid galena, was mined for about 40 feet horizontally. From the fourth to the fifth level there was a decrease in the value of the ore, due to the predominance of zinc blende, but from the fifth to the sixth level galena increased to the proportion shown in the upper part of the mine.

The 500-foot level contained good ore for a distance of 800 feet, and the upraise from it showed 12½ feet of almost solid galena. In the 200-foot drift of the 600-foot level, toward the end of the drift, the vein showed about as follows: Good ore, with quartz coming in toward right, 2 feet 9 inches; milling quartz, 8 inches; fair ore, with bunches of quartz, 7 feet.

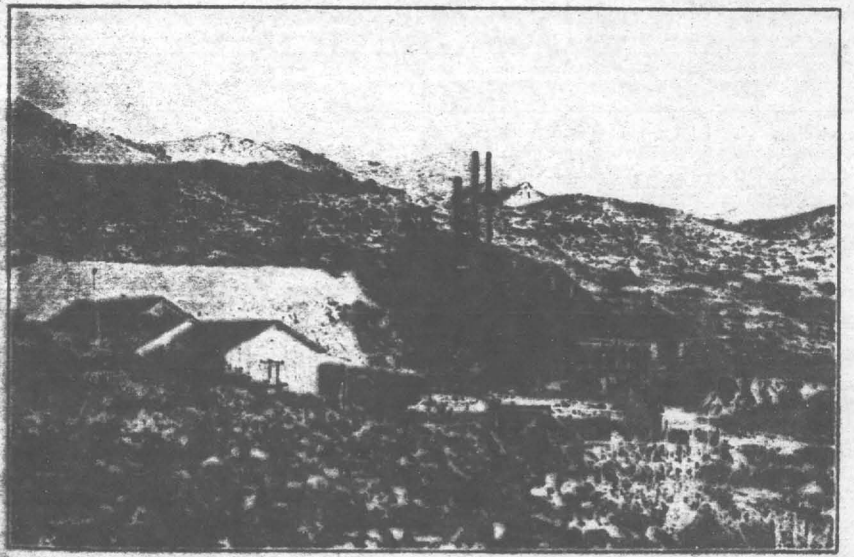
According to Comstock[a] the mine, about 1899, in its new workings encountered one of the buried older east-west auriferous veins or cross belts of mineralization, which increased the gold value of the mine product from $4 to $10 a ton.

No effort has ever been made to handle the zinc as a by-product, it being allowed to go into the tailings dump at the mill, which also contains values of the other metals, silver and gold. In addition, large bodies of good zinc ore, some 12 feet in width, on the 200-foot and 500-foot levels, have been left standing in the mine. The avail-

[a] Comstock, Theodore B., Geology and vein phenomena of Arizona: Trans. Am. Inst. Min. Eng., vol. 30, 1900, p. 1048.



A. ELKHART MINE AND MILL, LOOKING NORTHWEST.



B. TENNESSEE MINE AND MILL, LOOKING SOUTHEAST.

able tailings in the dump are estimated by H. L. McCarn at 12,000 tons, and they will concentrate about 60 per cent, or about 1 ton of zinc in 4 or 5, and will besides carry 8 to 10 per cent of lead and some silver and gold. Of zinc alone, by fine grinding and proper treatment, they are expected to yield about 300 tons of concentrates. There seems to be little doubt that the zinc, which heretofore has been regarded as a detriment, can be marketed at a good profit. In January, 1908, after the foregoing was written, Mr. McCarn informed the writer that the tailings were being worked over with jigs, tables, and electrostatic separators.

The most important of the surface improvements at the mine are a well-equipped steam concentrating mill, having a capacity of 100 tons in twenty-four hours, and two substantial steam hoists, that to the south having a capacity for a 1,000-foot shaft.

SCHUYLKILL MINE.

The Schuylkill mine, one of the oldest in the district, is about 1 mile northeast by east of Chloride, on a patented fractional claim adjoining the Tennessee on the north. It is on the west side of Tennessee Wash, and 100 feet above it, at an elevation of about 4,300 feet. It is owned by the Southwestern Mining and Smelting Company, a Pittsburg corporation.

The mine in early days was worked by Monroe Salisbury, who operated the Benson smelter, to which much of the ore was shipped. Later it was sold to the present company, which did the deep development work planned to extend to a depth of 1,000 feet, and is said to have blocked out much good ore ready for stoping when, about three years ago, work was suspended.

It is situated in alignment with the Tennessee and Elkhart mines and is supposed to be on the Tennessee vein (fig. 5); the country rock and ore are similar to those of the Tennessee mine. The vein here strikes N. 9° W. The large dump shows that much work has been done. The developments consist of a steam hoist, an excellent shaft 500 feet deep, two long crosscut tunnels, and considerable drifting and additional crosscutting. The mine has produced much good ore and has much more in sight reported to carry good copper and gold values. That from the surface workings was mostly of high grade. Rich silver-lead ore is also reported to occur on the 400-foot level, and on this and the lower levels are ores with native silver, running $100 a ton. The mine was closed at the time of the writer's visit.

ELKHART MINE.

The Elkhart mine (Pl. V, *A*) is situated a little more than a mile northeast of Chloride, west of Tennessee Wash, and adjoins the

Boy, Towne, Pinkham, Altata, Midnight, Minnesota-Connor, Elkhart, Schuylkill, Juno, and Pay Roll, the first seven being the principal present producers. Of these the Samoa, Minnesota-Connor, and Tennessee are the most prominent.

Tennessee mine.—The Tennessee mine is located a mile east of Chloride, at the base of the mountains, its elevation being 4,050 feet. The country rock is pre-Cambrian gneiss, with granite and schist occurring near by. The gneiss is composed essentially of sericitized feldspar and crushed quartz. The mine is located on the Tennessee vein, which further north has also been opened by the Schuylkill and Elkhart mines. It is developed to the depth of 600 feet by two shafts and six levels, which aggregate about 5,000 feet of workings. It produces some water. The principal surface improvements are a well-equipped 100-ton concentrating mill and two steam hoists.

The vein dips steeply to the east. The croppings show quartz stained brown or black by iron and manganese oxides. The walls are hard, smooth, and regular and show several systems of slickensiding. In places the vein itself is fissured. The ore contains the sulphides of lead, zinc, and iron, carrying silver values and some gold and copper. Its average run of mine, omitting zinc, is about as follows: Lead, 20 to 70 per cent, concentrates 75 per cent; silver, 8 ounces, concentrates 25 ounces; gold, small amount; copper, some in deep parts of mine. Of the output about one-third is high-grade shipping ore; the remainder is milled.

The mine has been productive from the surface. Thousands of tons of rich galena have been shipped to the smelter from the upper 400 feet. Here the ore shoot had a horizontal extent of about 250 feet, and was locally 15 feet in width. There is still much good ore in this section of the mine. On the 400-foot level solid galena was mined for a vein width of 21 feet and 5 inches, extending horizontally for about 40 feet. From the fourth to the fifth level there is a decrease in the value of the ore due to local increase of zinc, but from the fifth to the sixth level the ore again contains more lead. The 500-foot level contains good ore for a distance of 800 feet and the upraise from it yields much solid galena. Toward the end of the 200-foot drift north, on the 600-foot level, the vein now shows about as follows beginning on the hanging-wall side: Good ore with quartz coming in toward hanging wall, 2 feet 9 inches; milky quartz waste, 8 inches; fair-grade ore with bunches or lenses of feldspar and quartz, 7 feet. It is stated that the tailings on the dump contain much zinc blende which can be recovered by concentration. The ore is shipped to the smelter at Needles, on Colorado River, or to Deming, in southwestern New Mexico.

Samoa mine.—The Samoa mine is situated 3½ miles east of Chloride, near the crest of the range, at an elevation of about 6,000 feet.

Tennessee

Chloride and the Wallapai Mining District

(By PROF. F. C. SMITH, Chloride, Ariz.)

Despite the great war; despite the frivolity of metal prices; despite the countless burdens of cost laid upon the shoulders of the everyday man by the political gymnastics of the most remarkable administration with which this country has ever been—blessed; despite the chronic pessimism of omnipresent homunculi, whose sum-total of aspiration and vision may be limited by the portentious functions of the next pay-day; despite all these handicaps, and "the flu," and woman suffrage, and national prohibition (with no caps) and all of the eevryday trials and tribulations, Chloride keeps moving. She has a continually increasing number of mines in process of development in the immediate and tributary districts, with many indications today of a more solid and business-like procedure than ever before; this condition doubtless being caused not only by the fortunate development of good ore chutes, but also by a more comprehensive knowledge of the value of the ores mined. In the past, aside from the wasteful operations of a number of old-style concentrating mills, all ores from this district were shipped; sometimes to very great distances and even to Europe; and this fact had, to a certain extent, fixed the idea in the minds of the population that no different or less costly procedure would ever be possible. That the small gleanings of the "chlorider" as well as the larger tonnage of the deep mines must all be shipped—somewhere outside—and must thus stand the constantly increasing taxes of freight and immoderate smelter deductions and treatment charges. Today, glimmerings of the possibility of other and less expensive procedure pierce "the brick wall of prejudice," and the vast advantage attendant upon the erection of local mills—and mills erected in strict compliance with the startling advances in metallurgical knowledge—will serve as a sound basis for a system of operations which will very profitably replace that of the old days.

For these favorable conditions, and for the ultimate importance of Chloride—on a big scale—it may be as truly said of this mining area as of a certain notorious coffee-substitute—"there's a reason!" and this reason (supplemented by the certain promise of sensible milling) is becoming firmly fixed in the minds of a number of men who are both mentally and financially equipped to profit by it. The "reason" is this: That the Cerbat Range has the ore, and in vast amount! Only during the past week this reason has been enthusiastically expressed by two different mining operators of wide experience, and independently of each other; each of whom made substantially the following statement: "I have loked over practically all of the mining districts in North America, and I have come here to stay, for I have never seen a section of the earth of similar size so well mineralized." "Why man! even if you want to cut out the properties offered for sale, there are thousands of prospects which are opened to location which have been superficially opened twenty years ago and abandoned, which show conditions and values which, if they were—say in Tonopah, would be gobbled up at big prices." "The ore-chutes, as found in the main veins at least, go down; as shown in the only two deep mines you have, the Tennessee and the Golconda; what better do you want?" These ideas are not exaggerations; they are facts. If this be the case, the query arises as to just why these conditions have not been more largely exploited to profit. The answer is easy, although it is a function of several varieties:

(1) Strictly local milling of these complex ores (containing lead, zinc, copper, silver and gold in varying percentages) was the only economic procedure thirty years ago, as it is today. A very superficial consideration proves this axiomatic; since it is difficult to conceive a situation warranting the expense of wagon and railroad freights on waste. For many years (we might say even up to a year ago) the milling of complex ores has been in a very weak condition to say the least; the main function of the machinery supply houses being to sell the machinery, and let the buyer take his chances as to its adaptability. As a matter of fact, until the advent of flotation, no milling methods have been available which afforded more than a very rough and incomplete saving on such ores. Hence, many deposits of complex ores have hitherto been of only problematic value; since complete milling was impossible in many cases, and only the richest portions of the ore would pay for shipment.

(2) Minds unacquainted with the recent discoveries in the metallurgy of these ores have no recourse but to base their opinions as to their commercial value (and unfortunately, to broad-cast these opinions) upon past history, which includes the record of some salient mistakes and of higher costs than are necessary today; and it must be confessed that this category includes many visiting engineers, who camouflage a lack of the necessary technical knowledge to cover the situation wisely, bu such deductions from the past; fortifying their adverse conclusions by the use of maximum mining costs for the district (whether logical or not) together with maximum treatment and selling costs, backed up by minimum saving as obtained in some operating mill, whether the latter is properly efficient or not. These conditions unjustly, but quite frequently, befog the situation.

(3) The fallacy of the attempted exploitation of the complex ores of the district by laymen, profoundly ignorant of the enforced nicety of technical detail required, has strewn the district with pitiful wrecks which cannot fail to render observers skeptical of success. A few years ago there was some excuse for this condition; but today there is none.

Here, then, are a few of the reasons for the interrupted progress of Chloride, whereby it has evidenced repeated periods of great activity, with alternate periods of depression; explaining very fully why many promising ore-deposits have been abandoned before fruition, and why many investors have been afraid to proceed, or to properly finish what they have begun. Notwithstanding this limping progress, a real progress is being accomplished, simply as the natural result of the occurrence so many ore-deposits which simply ca be neglected; and there is a practical tainty of the early erection of a str modern and efficient mill for the t ment of the ores from the Schuylkill-T nessee mines. The erection of this should absolutely solve the problem Chloride's future; ridding it of the fur incubus of the installations of proc cranks and visionary dreamers, and lording a proper pattern for business operators.

The fact must not be omitted that th are already two small flotation mills h in this section; the Washington and Keystone. Neither of these has yet c into active operation, but there is reason to doubt their entire efficie when they do.

Among the mines, the Schuylkill-T nessee carries out a steady improvem and development policy; operating shifts and opening up new ore-reser against the day of production. Connec has recently been made with the 800-f shaft on the Schuylkill end-line, by raise from the Tennessee 900-foot l north, thus establishing the entity of one vein, draining the Schuylkill and ing better general ventilation.

The Cerbat Silver Mining Company actively operating the old Elkhart pr erty, northward on the same vein; us the Schuylkill shaft and surface pl and continuing the drift on the 800-le northward into Elkhart ground. This w bring the exploration some 300 feet bel the old Elkhart shaft, and in these n workings good ore has been already e countered. There are two parallel vein one carrying silver-lead ores, the oth pyritic gold ores.

Still to the northward, the Chlor Queen Company is drifting on the 25 foot level, and producing some very fi ruby silver ore. This property covers t intersection of some East-West silver vei which have produced a quantity of hig grade ore, with the North-South vei upon which are the mines above-men tioned.

A short distance east of the Tennessee an operation has been undertaken whic is of great interest to he whole district It consists of a double-track cross-cut tun nel, opened near the south end of th Payroll claim, which is to be driven abou two miles easterly to intersect and drai the many veins at great depths. The en terprise has been started by Colonel Ran kin, and the tunnel has a depth of some thing like 300 feet. It is understood tha T. B. Scott, the owner of the Payroll has become interested, and that the work will proceed without delay.

The Brunswick property, on the Ten nessee vein, has recently begun active op erations, and promises to take a prominen part in the ore production of the camp It is located a few hundred feet south o the Tennessee.

In this immediate vicinity and near the old Altata mine, the Rescue or Dorothy claim has recently jumped into prominence having produced and shipped some of the

finest silver ore which the district has ever yielded.

Late reports indicate that the three mining properties recently operated under the management of Mr. J. B. Hughes have been consolidated, and that active development of the entire group will be commenced at once.

The Emerald Isle Copper Company has recently shut down to make alterations in its electrolytic plant. This company has a large body of oxidized copper ore, occuring as a conglomerate, and it has already reached the production of two tons of metallic copper.

West of Chloride, in the flat country, the Tuckahoe is installing a heavy duty sinking pump, with the intention of sinking to the 1000-foot level; their ore as developed showing fine values in silver and gold with much less lead and zinc than is found in the ores of the main range. It is expected that the Diana will shortly resume work, as well as the Golden Cross Metals Co. Both of these properties carry fine-grained pyritic gold ores in a quartz matrix, especially well adapted to easy concentration.

The Rural and Buckeye mines in Mineral Park have been purchased by a syndicate represented by Mr. M. B. Dudley, and are being rapidly developed. The Rural is an old property which has not been worked in many years, but which has formerly filled the cabinets of Mohave County with the most magnificent specimens of native silver. After unwatering the shaft, conditions have been found of a much better character than could have been expected, and there is little doubt but the two properties will very soon become heavy silver producers.

The Washington mine, also in Mineral Park, is being rapidly brought to the production stage, as the mill is practically finished, and has already passed the experimental stage. The property shows several very interesting veins, with certain ore-chutes carrying high values in ruby silver. It is being operated by a syndicate, with Mr. F. E. G. Berry in charge.

Beside these properties, many others are showing activity with the advent of many substantial operators, and new finds are frequently reported. Many of the former residents of Chloride, who left the camp shortly after the war conditions became active, are returning; all expressing their vast satisfaction at their ability to resume life in "the finest mining camp they ever saw."

THE ARIZONA GEM MINES

(Special Correspondence)

Located at Mineral Park, 20 miles north of Kingman, Arizona, is perhaps the greatest producing turquois mines in the world. A large percentage of the stone is, however, of the poorer grade consisting of quartz and blended with turquoise and is called by the trade "matrix"; while quite attractive and has a large sale, it is never rated in price with the clear stone. The prices prevailing up to 1907 rranged from $2.50 to $12.50 per pound in the rough, but since that time prices have materially dropped, until for several years past these mines have been closed down.

The largest producing company, with the largest acreage, is that of the Aztec Turquoise Company of New York. This company was the pioneer, being followed by the Southwest Turquoise Company of Los Angeles, the Los Angeles Gem Company and the Arizona Turquoise Company of New York.

There is evidence that the mines were worked in the stone age as numerous stone hammers and hand clipping stones were found there. The late Jas. W. Haas was the original discoverer of the turquoise at Mineral Park, operating the old Montezuma mine in the Turquoise mountains southwest of Ithica Peak, but upon finding the later mines in the Ithica Peak country the old Montezuma mine was abandoned.

Another important deposit is that of Chrysophrase in the River range, some 18 miles north of Oatman. These properties are of late discovery and are expected to rival the famous old turquoise output, as it is of more commercial value and very rare. This gem is remindful of the remotest antiquity; a hard semi-translucent green stone, carrying stripes and colored with nickel. Perhaps the only operating mine of this stone in America today is located at Porterville, California, and owned in New York.

Owing to its high market value, all grades are used, comprising a dozen different grades from common to clear, and values run all the way from a few dollars to around $400 a pound.

STANDARD MINERALS DEVELOPING

A strike of gold and silver ore has been made on one of the claims of the Standard Minerals company, twenty miles east of Kingman. The company had been sinking a shaft on the Standard claim and at a depth of thirty feet ran into ore that gave results of from four to ten ounces gold and 325 ounces silver.

The vein in which the strike was made is about five feet in width, the rich streak having a width of from eighteen inches to thirty inches. The whole width of the ore-bearing streak is pay.

The Standard Minerals company has been operating a mill on its molybdenite properties and have been opening the ore bodies on the deep levels. The mill has been doing good work, a product of about sixty per cent molybdenite being secured. The company is understood to have contracts covering all the concentrates the mill can produce.

The mill is under the direction of S. S. Jones, who is also consulting engineer for the company. Mr. Jones is one of the best mining engineers and metallugists in the country and the Standard Minerals company is to be congratulated on securing his services. George Williston, a young engineer and metallurgist, is assistant to Mr. Jones in the mill work and Gerald Stimpson is general manager.

Through the hospital system the workmen of the Warren district get all medical care and surgical attention necessary for sickness and accident, and the families of the workmen get all medical attention.

The railroad from Cedar Glade to Clarkdale, the smelter town of the United Verde Copper company, runs through a miniature Grand Canyon; this has not been advertised to any extent, but it is a rare scenic attraction.

The Chloride Queen

The Chloride Queen Mining Co. has five claims and two fractions, over one hundred and twenty acres of ground in one block side-lining on the north side of the Cerbat Silver Mines Co. (known as the Elkhart mine) and end-lining the Empire property northeast of Chloride about one and one-half miles.

The equipment consists of one 12-H. P. hoist complete, one 60-H. P. oil burning Bessemer engine, Chicago Pneumatic compressor with capacity of 417 cubic feet, blacksmith shop fully equipped, change room, ore bins, and large galvanized iron building covering all the machinery.

The main shaft is timbered down 260 feet, with manway and working shaft, with a drift run at the forty level, 100-foot drift at 100 level, and at the 200 level the drift is in two hundred feet going under the hill, which when in about 200 feet more will give a depth of about 600 feet. Crosscuts have been run on this level 21 feet to the south and 22 feet to the north without encountering either wall. A good vein of ore at times widening to thirty inches has been continuous for over 100 feet, with values at times running over $150 a ton in silver, besides values in lead and gold. The drift is being pushed to the west on the east and west vein of the property, and well versed mining men say that the company will sure have a very large body of ore under the hill from all indications. One thing noticeable is that the work is being done on the east and west veins, which are so rich, leaving the north and south veins to be opened up later. These north and south veins have given up millions in rich ores, to such well known companies or properties as the Elkhart, Schuylkill, Distaff, Schenectady and Tennessee in this immediate vicinity.

It is the intention of the management to run the drift under the hill and open up the ore and go on a producing basis. In fact, the first car of ore will be shipped to the Selby smelter within a month. The short haul of one mile with a good road from shaft to the railroad at the Tennessee mine is an added feature of low production cost to the company. The Chloride Queen Mining Co. has hundreds of feet of stoping ground from the 200-foot level up carrying rich values in silver ores, besides the hundreds of feet of ground below this level which will be opened up as the property is developed, and which is assured by what the Elkhart and Tennessee properties have proven, and especially the latter, which has a depth of 1400 feet, with valuable ore practically all the way, and a reported production in the past of something like $18,000,000. One must not lose sight of the fact that the Elkhart, which side-lines the Chloride Queen on the south, is reported to have produced over one million dollars with deepest workings 500 feet.

The management of the Chloride Queen Mining Co. is confident that their property with proper development in the next few years will produce its millions in rich silver ores, and with present prices of silver the outlook for the company to go on the dividend-paying basis in the very near future is of the best.

TENNESSEE - SCHUYLKILL

Located in Wallapai mining district, Sec. 3,T 23 N, R 18 W, and Sec. 34, T 24 N, R 18 W. Seven patented and three unpatented lode claims.

The Tennessee Mine is opened by two shafts, the Tennessee shaft and the Schuylkill shaft. The Tennessee shaft is vertical and is 1400 feet in depth. The Schuylkill shaft is an incline of about 80° and is 800 feet deep. Both shafts are in the footwall of the vein.

The Tennessee mine is said to have been discovered in 1894 by A. M. MacDuffee and operated intermittently by MacDuffee and other operators up to 1912. Lead was the chief product of these operations; the zinc being left in the stopes where possible. In 1913 the Needles Mining and Smelting Company, a subsidiary of the United States Smelting, Refining and Mining Company, obtained a lease on the property and after putting down the present shaft to a depth of 1400 feet, operated it continuously until 1917. A jig-mill concentrate was shipped to a smelter erected at Needles, California.

After this period the mine remained inactive until 1928 when the Monark Lead Company brought the Tennessee and the Schuylkill mine to the north under one management. A 150 ton flotation mill was erected at this time but did not operate because of the low base metal prices prevailing after the 1929 collapse.

Early in 1936 the Tennessee-Schuylkill Corporation was formed, the mine unwatered and cleaned out, and production started toward the end of 1936. There followed a period of large production, 1937 showing the greatest production of any year of operation. It was during this time that most of the Schuylkill ore body was mined above the 900 level and parts of the Tennessee chute adjoining the old workings of the Needles Smelting and Refining Company. The operators were just starting to mine the high grade zinc ore above the 1000 level when low base metal prices at the beginning of the year 1939 forced the mine to close.

These prices did not rise until nearly the end of the year, and the mine was reopened in November, 1939. The 1000 level stopes were opened up again and the 1200 level was driven northerly on the vein. While the showing below the 1000 stopes was disappointing they continued the 1200 drift and soon came into very good ore which developed into the 1228 stope and those above and below.

On the strength of this showing it was decided to drive the 1170 level farther north. This resulted in the finding of an entirely new ore body, the 1170 NC. Up until this time it was thought that the Tennessee north ore shoot stopped at a fault striking nearly normal to the vein and dipping about 55° to the north. This was the first instance where ore occurred in the hanging wall of this fault.

At about this time the 1250 winze was sunk to the 1350 level to develop the ore mined in 1328 stope.

Shortly after this, in February, 1942, it was decided to prospect the Tennessee vein south of the Tennessee shaft. After a diamond drilling campaign, sufficient evidence was obtained to warrant a crosscut to the vein due east of the shaft. This crosscut was driven and the 900 south orebody opened up. The ore in this shoot has proved to be lower grade than that in the north end of the mine, with gold and silver values especially low. The vein, however, is wide and has produced substantial tonnage of a good grade of lead-zinc ore.

The Tennessee vein is a true fissure vein striking about N 70° W and dipping about 85° to the east. Signs of considerable movement are shown in the vein in the presence of heavy gouge and often the walls show strong slickensides. The vein consists of galena and sphalerite containing small amounts of gold and silver, as the ore minerals, with a gangue of quartz, pyrite, calcite and highly altered wall work. In the Schuylkill ore shoot the pyrite contains the gold values which are higher in this part of the mine.

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GOLD, SILVER, COPPER, LEAD AND ZINC RECOVERED FROM ORES
at the
TENNESSEE - SCHUYLKILL MINE
Chloride, Arizona
from
1901 to 1943

Year	Tons Ore	Tons Concentrate	Ounces Gold	Ounces Silver	Pounds Copper	Pounds Lead	Pounds Zinc
1901	25,805		8.87	2,469		4,421,678	
1902	7,567		85.89	29,448		1,619,640	
1903	1,090		15.26	4,360		279,468	
1907	154		23.89	2,047	235	90,960	
1910	70	10	3.22	127		6,654	
1911	998	328	78.63	2,638	1,837	97,572	87,486
1912	1,358	988	266.67	13,127	2,361	459,771	260,966
1913	29,486	14,360	1,370.29	106,924	16,568	4,740,278	4,233,642
1914	22,081	12,671	739.15	74,748	11,981	3,657,302	4,932,108
1915	47,633	22,187	2,191.00	171,366	45,000	6,034,998	8,351,839
1916	47,013	19,777	1,564.00	135,158	32,285	5,086,177	7,517,627
1917	41,133	21,347	1,914.00	160,981	55,300	5,039,156	8,352,860
1926	164	71	12.71	819	435	32,024	32,697
1929	58	29	4.41	307	183	15,142	13,008
1936	12,233	3,239	2,870.00	40,850	24,300	1,433,000	1,000,000
1937	59,990	12,084	10,467.00	138,960	100,000	4,553,000	3,414,000
1938	54,092	11,340	9,642.56	107,720	86,500	3,792,450	5,449,656
1939	11,762	3,197	1,088.60	24,198	22,280	676,560	1,624,000
1940	55,577	17,521	3,249.51	132,775	19,880	4,607,740	9,543,100
1941	45,150	10,590	2,843.28	113,061	11,340	4,854,860	4,330,580
1942	40,055	7,552	2,278.08	100,194	17,160	3,284,880	3,383,980
1943	38,286	6,115	1,079.63	71,698	58,521	2,677,185	3,492,209
	541,755	163,406	41,796.65	1,433,975	506,166	57,460,495	66,019,758

1944 PRODUCTION

Period	Tons	Average Grade Au	Ag	Pb	Zn
Year 1943	38,286	.036	2.01	3.70	5.91
Jan.,1944	2,298	.037	2.76	4.81	8.14
Feb., "	1,982	.043	2.85	4.59	8.08
Mar., "	1,978	.039	1.89	3.79	5.96
Apr., "	2,683	.033	1.77	3.35	6.90
* May, "	3,019	.024	1.23	2.58	4.75
June., "	2,407	.032	1.92	3.49	6.66
July, "	2,480	.030	1.48	3.32	5.82
Aug., "	2,170	.029	1.32	3.32	5.26

* 1,377 tons dump ore included

GOLD, SILVER, COPPER, LEAD AND ZINC RECOVERED FROM ORES
at the
TENNESSEE - SCHUYLKILL MINE
Globeville, Arizona
from
1901 to 1913

Year	Tons Ore	Concentrate	Ounces Gold	Silver	Copper	Pounds Lead	Zinc
1901	25,805		8.87	2,169		4,421,678	
1902	7,567		85.09	29,448		1,619,680	
1903	1,090		15.26	4,360		279,468	
1907	158		23.89	2,047	235	90,960	
1910	70	10	3.22	127		6,658	
1911	998	328	78.63	2,638	1,837	97,572	87,486
1912	1,358	988	266.67	13,127	2,361	459,771	260,986
1913	29,486	14,360	1,370.29	100,924	16,568	4,423,682	4,233,682
1914	22,082	12,671	739.15	74,748	11,981	3,652,302	4,932,108
1915	47,633	22,187	2,191.00	172,366	45,000	6,094,998	8,351,839
1916	47,013	19,177	1,586.00	136,148	32,286	5,086,117	7,317,627
1917	43,133	21,347	1,918.00	160,983	55,300	5,029,158	8,352,060
1926	1644	71	12.71	819	435	32,021	32,697
1929	58	29	4.42	307	183	15,112	13,008
1936	12,233	3,239	2,870.00	40,850	24,300	1,433,000	1,000,000
1937	59,990	12,084	10,407.00	138,960	100,000	4,552,000	3,414,000
1938	54,092	11,340	9,842.56	107,720	86,500	3,782,450	5,449,656
1939	44,762	3,197	1,088.60	24,328	22,280	676,560	1,628,000
1940	55,577	17,521	3,249.51	132,775	18,880	4,607,780	9,543,200
1941	45,150	10,590	2,843.28	113,061	11,340	4,058,860	4,330,580
1942	40,055	7,552	2,278.08	100,748	17,160	3,284,880	3,383,980
1943	38,286	6,135	1,079.63	41,698	58,521	2,017,185	3,492,209
	514,295	161,900	44,796.05	1,433,975	509,186	57,460,495	66,029,758

1944 PRODUCTION

Period	Tons	Au	Ag	Pb	Zn
Year 1943	38,286	.036	2.01	8.78	5.91
Jan., 1944	2,298	.037	2.76	4.81	8.14
Feb., "	1,982	.043	2.85	4.39	8.08
Mar., "	1,978	.039	1.89	3.79	5.96
Apr., "	2,683	.033	1.77	3.35	6.90
* May, "	3,019	.024	1.23	2.58	4.75
June, "	2,407	.032	1.92	3.49	6.66
July, "	2,480	.030	1.48	3.32	5.82
Aug., "	2,170	.029	1.32	3.32	5.26

* 1,377 tons dump ore included

USGS Bull 978-E 1957

The Wallapai Mining District
Cerbat Mountains
Mohave Co. Az.

(1)

1. Combined output of Golconda & Tennessee mines from 1904-1948
   54,760 Tons Zinc + 35,736 Tons Lead

2. Pre-Cambrian basement intruded by younger Laramide rocks.
   Granite, Schist, Gneiss + amphibolite.

3. Mineralization is generally in the Laramide intrusive in pre-€ rocks

4. Typical ore occurs in pyritic qtz veins & lodes formed at intermediate depths - in oxidized zone - up to 150' thick

5. Veins range considerably in thickness but average 3-4 feet
   only a few exceed a length of 1 mile

6. The oxidized zone averages 150 feet in depth, commonly contain cerargyrite, native gold, Galena + Cerussite.

7. The primary ore consists chiefly of sphalerite, galena, pyrite & some chalcopyrite

8. The sulphides occur in irregular masses + in crudely banded forms in Quartz gangue.

9. Ore shoots vary greatly in size, but the smaller ones, averaging about a foot in thickness & 30 ft in length & breadth

10. Primary enriched zones are commonly, though not always, found at abrupt changes in strike of the veins & also at junction of branch veins

11. Mineralization took place probably in the Mesozoic (Laramide) & probably are genetically related to a granite intrusion exposed near the central part of the district

Pre-Cambrian Crystalline Rocks. — Amphibolite & related Gneiss & Schist

Mostly Granite exposed f dark gr. white to dk Black, Commonly lt. grey. considerable biotite.

Weathers light buff & locally reddish Brown

Commonly lt grey, med. gr. gneissoid Granite w/small amounts of basic minerals

Basic Rx are generally dark in color & very heavy.

July - Sept., 1976

Core	Sample No.	Auger Hole Depth Ft.	Gold oz/T	Silver oz/T	Cu %	Pb %	Zn %		
	A-1	12.6	0.012	0.31	0.03	0.19	0.83		
	A-2	14.0	.004	0.32	0.02	0.13	1.08		
	A-3	15.1	.015	0.33	0.02	0.15	1.56		
	B-1	19.8	.005	0.15	0.02	0.16	0.90		
	B-2	24.2	.010	0.39	0.02	0.15	1.11		
	B-4	13.0	.015	0.44	0.02	0.17	1.07		
	C-1	33.0	0.11	0.28	0.03	0.21	0.98		
	C-2	28.1	.015	0.31	0.03	0.28	0.74		
	C-4	15.5	.010	0.33	0.03	0.12	1.12		
	Jig Tails At Top		0.011	0.45	0.05	0.37	1.01		
	"		.001	0.32	0.03	0.23	0.73		
B-1	Preliminary Auger Holes	Tailings 0-18.3	0.005	0.19	0.06	0.17	1.98		
	" "	18.3-28.9	.031	0.38	0.04	0.14	1.13		

Symbol	Definition
T	Toe
C	Crest
GI	Dump & Ground Intersection
A	Transit Location
◯	Sample Location

SCALE 0 5' 30' 40' 60'

Traced 2-11-77
Revised 2-41-77

TENNESSEE

AUGUST 1976

CETA MINING STUDY

T-23N
R-18W
Sec. 2