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branch slips, as in the ground at the south end of the 500-foot level, a wide zone was opened up and replaceable beds locally became permeable for some distance from the main fractures. In such areas metallization was more extensive than where the rock was less shattered, and "blanket" or bedding plane ore formed in calcareous beds. Unfortunately, most of the bedding plane ore does not mill well and is high in zinc.

MOUNTAIN CITY (COPE, VAN DUZER, RIO TINTO) DISTRICT
Copper, silver

Sources of information

Emmons, W. H., 1910, A reconnaissance of some mining camps in Elko, Lander, and Eureka Counties, Nevada: U. S. Geol. Survey Bull. 408, p. 80–84.

Lincoln, F. C., 1923, Mining districts and mineral resources of Nevada: Nevada Newsletter Pub. Co., Reno, p. 52.

Nolan, T. B., 1932, The Mountain City mining district: Unpublished report in files of U. S. Geol. Survey.

Eng. and Min. Jour., 1937, 1938, 1939, Notes on Mountain City: v. 138, No. 1, p. 33; v. 139, No. 10, p. 64; v. 139, No. 12, p. 64; v. 140, No. 9, p. 66; v. 140, No. 10, p. 74.

Matson, E. J., 1947, Rio Grand copper deposit, Elko County, Nevada: U. S. Bur. Mines Rept. Inv. 4120, 6 p.

Stephens, E. C., 1950, Geology of the Mountain City copper mine and Mountain City quadrangle: Unpublished report, International Smelting & Refining Co., Salt Lake City, Utah.

The Mining Record, 1950, v. 61, No. 49, p. 3; v. 61, No. 52, p. 3.

Location

Mountain City or Cope district is in the Centennial Range 100 miles north of Elko. State Highways 11 and 43 provide a direct all-weather route through the center of the district and connect Mountain Home, Idaho, to the north with Elko to the south. Most of the district is in Tps. 45 and 46 N., R. 53. E.

History and production

The district was discovered in 1869 by James Cope. During the 1870's there was considerable activity, and prior to 1881 a reported production of more than $1,000,000 in silver was made from rich but shallow oxidized ores. Production of silver ores has been negligible since the early exhaustion of the rich surface ores. There has also been a small production of placer gold, estimated at less than $150,000.

Amount and values of annual production from the Mountain City district, 1869 to 1949, is contained in table 6. Figures representing the copper production of the Rio Tinto mine have been modified somewhat from the figures contained in the Mineral Yearbooks by incorporation of production data received from the International Smelting & Refining Co.

A revival of mining in the district in 1932 was due to the persistence of S. F. Hunt. In 1919 Hunt located claims on the gossan that overlies the Rio Tinto ore body. Persistent work, under great difficulty and with inadequate financial resources, was rewarded in 1931 by the discovery of rich secondary copper ore beneath the gossan at a depth of 242 feet. The International Smelting & Refining Co. purchased a controlling interest in the property, and active production continued until the exhaustion of the deposit in 1948. Since that time prospecting has not been successful in discovering additional ore bodies.

Geology

The district is underlain by a thick series of Paleozoic rocks, in part of Carboniferous age, which were intruded by great masses of quartz monzonite and later almost completely buried beneath Tertiary lavas. The Paleozoic rocks have in general a westerly strike and a northerly dip and are cut by thrusts and normal faults. The following summary description is largely abstracted from both Nolan's and Stephens' reports.

A thrust fault crops out south of the Rio Tinto mine and divides the Paleozoic rocks into two groups of formations which as yet cannot be correlated.

Formations of the upper plate.—The "footwall" quartzite (Blackrock quartzite of Stephens) is the only formation of the upper plate group that crops out in the area shown in plate 14. The rocks are a light-colored medium-grained quartzite showing little variation in texture or composition. Stephens estimates a minimum thickness of 1,000 feet.

Formations underlying the "footwall" quartzite and outcropping to the south of the area covered by plate 14 are given by Stephens as follows:

(Top)	Feet
Shale, black and gray	540
Quartzite, massive, resistant, locally crossbedded	2,500
Chert with varying amounts of shale, schist, and sandstone	5,000–7,000
Limestone, bluish gray, with argillaceous members and narrow quartzite lenses.	

TABLE 6
PRODUCTION FROM MOUNTAIN CITY MINING DISTRICT, 1869–1949

Year	Tons of ore	Gold		Silver	
		Ounces	Dollars	Ounces	Dollars
1869	250*				
1870	1,750*				
1871	2,178				
1872	718				
1873	378				
1874	500*				
1875	2,500*	4,523*	$93,500*	880,000	$1,100,000*
1876	123				
1877	2,500*				
1878	2,500*				
1879	1,544				
1880	2,141				
1881–1904*	444	118	2,439	44,550	38,680
1905	300	6*	130*	1,836*	1,820*
1906*	1,000	22	433	8,985	6,115
1907	1,858	58*	1,196*	24,440*	16,175*
1908*	0	0	0	0	0
1909*	0	0	0	0	0
1910*	0	0	0	0	0
1911*	0	0	0	0	0
1912*	0	0	0	0	0
1913*	0	0	0	0	0
1914	0	25*	517*	0	0
1915	12*	12*	248*	436*	221*
1916*	0	0	0	0	0
1917*	0	0	0	0	0
1918*	0	10	207	0	0
1919*	0	0	0	0	0
1920*	0	0	0	0	0
1921*	2,000	194	4,000	176,000	176,000
1922*	0	0	0	0	0
1923–1925*	0	0	0	0	0
1926*	20	2	40	2,805	1,750
1927–1928*	0	0	0	0	0
1929*	12	1	24	1,970	1,050
1930*–1931	0	0	0	0	0
1932	1,457	36*	750*	22,925*	6,462*
1933	0	0	0	0	0
1934	7	7	242	401	259
1935	15,831	28	970	5,875	4,223
1936	70,479	154	5,380	19,848	15,372
1937	156,395	137	4,795	20,933	16,192
1938	66,600	103	3,605	10,198	6,592
1939	134,788	113	3,955	39,690	26,910
1940	144,307	680	23,800	52,758	37,511
1941	132,784	2,666	93,310	41,244	29,324
1942	116,757	389	13,615	18,883	13,426
1943	4,394	41	1,435	1,833	1,303
1944	19,487*	59	2,065	3,338	2,373
1945	9,723*	38	1,330	1,465	1,042
1946	1,833	27	945	738	596
1947	25,071	493	17,255	43,973	39,796
1948	1,200	960	33,600	45,688	41,348
1949	155	175	6,125	1,777	1,594
Totals	923,996	11,077	$315,911	1,472,589	$1,586,134

*Estimated or partly estimated.

TABLE 6—Continued

PRODUCTION FROM MOUNTAIN CITY MINING DISTRICT, 1869–1949

Copper Pounds	Copper Dollars	Lead Pounds	Lead Dollars	Total value	Year
0	0	10,000*	$500*	$25,000*	1869
				175,000*	1870
				89,032	1871
				36,054	1872
				33,000	1873
				41,962*	1874
				200,000*	1875
				6,641	1876
				200,000*	1877
				200,000*	1878
				85,192	1879
				102,119	1880
0	0	65,400	2,681	43,800	1881–1904*
0	0	0*	0*	1,950	1905
0	0	912	52	6,600	1906*
0	0	11,641*	564*	17,935	1907
0	0	0	0	0	1908*
0	0	0	0	0	1909*
0	0	0	0	0	1910*
0	0	0	0	0	1911*
0	0	0	0	0	1912*
0	0	0	0	0	1913*
0	0	0	0	517*	1914
0	0	2,127*	100*	569	1915
0	0	0	0	0	1916*
0	0	0	0	0	1917*
0	0	0	0	207	1918*
0	0	0	0	0	1919*
0	0	0	0	0	1920*
0	0	0	0	180,000	1921*
0	0	0	0	0	1922*
0	0	0	0	0	1923–1925*
0	0	0	0	1,790	1926*
0	0	0	0	0	1927–1928*
0	0	0	0	1,074	1929*
0	0	0	0	0	1930*–1931
139,200*	$8,395	0	0	15,607	1932
0	0	0	0	0	1933
0	0	0	0	503	1934
7,945,916	659,511	43,783	1,751	666,455	1935
25,113,496	2,310,442	0	0	2,331,194	1936
33,176,600	4,014,369	100	6	4,035,362	1937
13,125,500	1,286,299	500	23	1,296,519	1938
28,129,700	2,925,489	0	0	2,956,354	1939
27,084,500	3,060,548	9,600	480	3,122,339	1940
21,511,600	2,538,369	8,900	507	2,661,510	1941
14,148,600	1,711,981	0	0	1,739,022	1942
2,170,064	282,108	0	0	284,846	1943
9,624,357	1,299,288	0	0	1,303,726	1944
4,804,445	648,600	0	0	650,972	1945
611,153	99,007	0	0	100,548	1946
2,209,600	464,016	26,500	3,816	524,883	1947
27,400	5,946	11,800	2,112	83,006	1948
25,100	4,990	1,600	208	12,917	1949
189,847,231	$21,319,358	192,863	$12,794	$23,234,197	

*Estimated or partly estimated.

Formations of the lower plate.—The Rio Tinto formation is the lowest exposed unit of the lower plate sequence and forms the wall rock of the Rio Tinto copper mine. The formation consists predominantly of fine-grained quartz-sericite schist, shale, and locally of fine-grained dark quartzite and dense black chert containing poorly preserved Radiolaria. Quartzite crops out principally as a thick bed southeast of the mine, but thin beds or lenses are present throughout the formation. Nolan estimates the minimum thickness at 4,000 feet. Stephens gives 2,085 feet, possibly excluding the thick quartzite mapped separately by Nolan. The age of the Rio Tinto formation has not been established. It is overlain unconformably by the Banner limestone.

The Banner limestone consists chiefly of thick-bedded grayish-blue limestone, altered to silicates in a wide zone adjoining the quartz monzonite contact. At the base of the formation is a variable amount of basal conglomerate, grading into quartzite. The Banner limestone yielded a few silicified corals and a *Productus*, considered by G. H. Girty to indicate a late Mississippian age. However, more recent studies (Helen Duncan, U. S. Geological Survey, personal communication) suggest an age assignment of "probably Pennsylvanian or Permian (?)" would be more advisable. The formation pinches out to the west. Its maximum thickness is estimated by Nolan at 500 to 600 feet and by Stephens at 1,100 feet.

The Nelson amphibolite, forming a narrow band between the Banner limestone and the Mountain City formation, is a much altered basic igneous rock originally of andesitic composition; it may be either a flow or an intrusive sill.

The Mountain City formation consists of dark siliceous schist, in part calcareous, with interbedded quartzite, totaling at least 2,000 feet. The rocks are metamorphosed adjacent to the quartz monzonite intrusive.

Quartz monzonite.—Quartz monzonite underlies a large area north of the district. Discontinuous outcrops are present northward to the Idaho line, and Nolan considers it likely that the intrusion is genetically related to the Idaho batholith. The rock is light colored and coarse grained, with large crystals of potash feldspar and smaller crystals of plagioclase, biotite, and abundant quartz. Aplite dikes consisting essentially of quartz and perthitic orthoclase are common. Porphyry dikes are present in the Rio Tinto mine, according to Stephens.

Tertiary lavas.—Lavas and tuffs rest on the eroded surfaces of the older rocks; in the Mountain City district only small erosion remnants are present, but to the east and north the lavas cover a large part of the area. Within the Mountain City district the rock is a rhyolite, remarkable for the presence of phenocrysts that approach albite in composition. The age of the lavas is not known. Nolan suggests these lavas may be related to the volcanics of Pliocene age of southwestern Idaho and southeastern Oregon.

Terrace gravels.—In the eastern part of the area, mostly between the 5,500- and 5,700-foot contours, the bedrock geology is concealed by quartzite gravels, possibly deposited when the regional drainage was to the southeast.

Structure.—In the Mountain City district and surrounding area the regional trend of the Paleozoic rocks is westward; the sediments have a prevailing northerly dip and are not closely folded. According to the view here accepted they are cut by a thrust fault that carries the "footwall" quartzite above the Rio Tinto formation.

Studies by Nolan and Stephens are not in agreement on interpretation of structure. Mapping by Stephens shows that the formations to the south cannot be correlated with those to the north. The displacement along the thrust fault, mapped by Nolan, cannot be determined. Stephens does not recognize the thrust fault mapped by Nolan and considers that there is a single north-dipping sequence of Paleozoic rocks. Visits to the district lead the writers to prefer Nolan's interpretation.

Normal faults are of different ages: some are older than the quartz monzonite; others cut the quartz monzonite and have served as channels for mineralizing solutions of the silver ores; a younger group displaces the Tertiary lavas. Stephens points out that most of the faults that are older than the quartz monzonite have a northwesterly strike and a relatively large horizontal component of movement. The younger faults have generally a more northerly strike and vertical displacements of not more than a few hundred feet.

Topography.—Stephens points out that after the extrusion of the lavas the drainage was to the southeast into the Basin and Range Province. Gentle southward tilting is assumed to have locally ponded the runoff sufficiently to allow the accumulation of the terrace gravels. This stage was ended by the encroaching streams of the Columbia-Snake River drainage system, which captured the earlier drainage and reversed it to the present northward direction.

Silver veins and mines (abstracted from Emmons, 1910)

The silver-bearing quartz veins are near the quartz monzonite contact or within the intrusive body. The veins occupy sharply defined fissures; even where they are in limestone the walls are sharp and there is little replacement. Where they cut the quartz monzonite there is but slight alteration of the wall rock except for some sericitization, alteration of the ferromagnesian minerals, and the introduction of pyrite.

The unoxidized ore contains pyrite, galena, sphalerite, tetrahedrite, arsenopyrite, and a little chalcopyrite, also argentite and free gold in a quartz gangue. In the oxidized ore the following were noted: "quartz, chalcedony, cerargyrite, pyromorphite, iron oxides, native gold and silver, lead carbonate, copper carbonate, and copper silicate." Brittle silver (stephanite) and pyrargyrite are also reported. Depth of oxidation is irregular, in places sulfides were found a few feet below the surface, but elsewhere oxidation extended to depths greater than 250 feet. The veins are much faulted, mostly by normal faults at angles to the veins, but in places the quartz is shattered and brecciated by movement along the walls of the original fissure.

The production appears to have been derived almost exclusively from rich oxidized ores. As with many deposits of this type in Nevada, shoots of primary ore are too scattered and of too low grade to be profitable. In spite of intensive prospecting, production of silver ore during the past half century has been insignificant. Descriptions of individual mines visited by Emmons in 1908 are summarized below.

Protection mine.—The deposit exploited by the Protection mine, three-fourths of a mile below Mountain City, was one of the early discoveries of the district and was worked in the early 1870's when considerable chloride ore is said to have been treated in a silver mill nearby.

The Protection vein is a fissure filling in quartz monzonite with a maximum width of about 4 feet. The sulfide ore is composed of quartz, pyrite, galena, sphalerite, tetrahedrite, stephanite, and proustite or ruby silver. The oxidized ore is stained with iron and manganese oxides and contains cerargyrite, a little copper carbonate, pyromorphite, and a yellowish-green mineral said to be silver bromide. At some places near the vein the wall rock is but little altered; at others it is a light-colored decomposed rock, the ferromagnesian minerals having been leached out and the feldspar sericitized.

Resurrection mine.—At the Resurrection mine, a few rods north of Mountain City, a large amount of work has been done in tunnels, pits and shallow inclines; but most of the workings were inaccessible when the mine was visited by Emmons in 1908. The country rock is quartz monzonite, with flows of rhyolite and basalt to the east. The highly altered quartz monzonite is sheeted by closely spaced fissures that strike northeastward. Several narrow quartz veins cut the quartz monzonite parallel to the sheeting. Near the surface where the ore has been oxidized it is composed of quartz, cerargyrite, lead carbonates, and iron oxides; the primary sulfides are galena, tetrahedrite, a little pyrite, and chalcopyrite. In the 1870's considerable rich chloride ore was taken from the surface pits and worked in silver mills nearby.

Nelson mine.—The Nelson mine is on a branch of the north fork of the Owyhee River, about 1¾ miles above Mountain City. The mine contains some 4,000 feet of workings, mainly on two adit levels about 100 feet apart vertically. The country rock of the mine consists of quartz monzonite, limestone, and aplite. The quartz monzonite intrudes and metamorphoses the limestone with the formation of epidote, actinolite, garnet, and mica in the limestone. In places this rock is so rich in actinolite that it has the appearance of a basic igneous rock and has been mistaken for diabase. The quartz monzonite is cut by aplite dikes and irregular intrusive masses. The ore deposits are fissure fillings 1 to 3 feet wide that occur in quartz monzonite, limestone, and aplite. Several veins crop out boldly on the hill above the mine, cutting across beds of metamorphosed limestone. The veins cross the contact of igneous and sedimentary rocks without interruption, but they have been developed mainly in the quartz monzonite. The sulfide minerals present are pyrite, galena, sphalerite, tetrahedrite, chalcopyrite, arsenopyrite, and a small amount of ruby silver and argentite. Native silver and cerargyrite are present near the surface, where the ore is stained with copper carbonates, iron oxides, and manganese oxides. Free gold, some of it crystalline, is associated with quartz and brown iron oxide.

The Standard vein, developed in the lower tunnel, strikes southeastward and has been followed for about 1,000 feet, with overhead stoping here and there. This vein is broken at three places by normal faults that strike eastward and dip northward at various angles. One of the faults has displaced the vein horizontally about 150 feet; horizontal displacement along the other two faults is less than 15 feet.

Mountain City mine.—The Mountain City mine is located about a mile southwest of Mountain City, at the top of a low, flat ridge that rises some 200 feet above the Owyhee River. The country rock is a metamorphosed black, shaly limestone that strikes eastward and dips 50° N. The lode is a fissure vein that cuts across the limestone, striking N. 50° W. The ore is highly siliceous and is a simple fissure filling, cementing angular fragments of the altered limestone. It carries silver chloride and native silver, and in the 1870's according to report, several hundred thousand dollars' worth of silver ore was taken from the deposit through a shaft now inaccessible. About 500 feet S. 75° E. of the principal workings of the Mountain City vein and lower on the hill are a number of open pits, some of which have been sunk on a vein striking N. 32° W. that possibly is the faulted continuation of the Mountain City vein. The country rock of the lower deposit is a dark-gray metamorphosed limestone flaked with tremolite crystals. An adit was driven 95 feet N. 70° W. to the vein, following it for 90 feet, and a winze was sunk on the ore body 60 feet below the adit level. The deposit is a fissure vein and at some places a sheeted zone composed of several narrow veins with slabs of limestone between. Much movement has occurred since deposition, for at places the quartz is brecciated almost to powder. The ore is composed of quartz, iron oxides, copper carbonates, and silicates, and a little pyrite is present at the bottom of the winze. The vein strikes N. 32° W., dips 56°–85° S., and has a maximum width of 5 feet.

Rio Tinto copper deposit (abstracted from Stephens, 1950)

The Rio Tinto ore body crops out in the middle of the exposed portion of the Rio Tinto formation. The following description of the deposit is based on Stephens' unpublished report.

Gossan and oxide zone.—At the surface the gossan consists of a porous mass of iron oxides and quartz. Locally a few small specks of malachite, azurite, and cuprite have been observed. The oxide zone extended from the surface to the 200-foot level, the position of the water table at the time of mining. From the surface nearly to this level the oxide zone consists of a porous mass of quartz and iron oxides diversified by streaks of yellow-brown mud. At the base a zone 9 to 20 feet thick contains flat-lying bands of massive brown iron oxide and quartz. The boundary between the oxide and sulfide zones was very sharp, commonly with not more than 6 inches of transition material. At one place, however, the lower 20 feet of the oxide zone contained sufficient malachite, azurite, cuprite, native copper, and residual sulfides to constitute shipping ore.

Sulfide zone.—The ore below the oxide zone consisted essentially of chalcopyrite and pyrite with subordinate amounts of bornite enriched by replacement with sooty chalcocite, covellite, and locally massive chalcocite. In general, supergene enrichment extended 125 feet below the base of the oxide zone with local prongs extending to a maximum depth of 175 feet.

Ore bodies.—Two distinct types of ore bodies were present, massive replacement deposits and disseminated deposits. The massive replacements were lenticular in form, with the longest dimension of the deposit parallel to the bedding of the enclosing rock.

Six varieties of ore were distinguished in the replacement deposits:

1. Massive pyrite quartz ore, usually on the hanging wall of the ore body. Chalcopyrite was finely scattered through an intimate mixture of pyrite and quartz. Locally a little sphalerite was present. Copper content seldom exceeded 10 percent.

2. Dark-gray quartz ore. Massive to banded quartz with pyrite, chalcopyrite, and supergene copper minerals as blobs, streaks, and irregular patches.

3. Replaced quartzite ore, which formed only a small part of the ore body. Dark massive quartzite with discontinuous quartz veinlets carrying pyrite and chalcopyrite, replaced in the superegene zone by chalcocite. Copper content seldom exceeded 5 percent.

4. Banded quartzose ore. Numerous tiny veinlets of glassy quartz with pyrite and chalcopyrite cut across bands of quartz, representing an earlier silicification, at acute angles. The rock was loose and broken and favorable for supergene enrichment. Copper content in the supergene zone ranged from 35 to 55 percent.

5. Massive sulfide ore that contained primary and secondary copper sulfides, quartz, and coarsely crystalline pyrite. Copper content ranged from 25 to 55 percent.

6. Altered shale, present only along the footwall, contained scattered pyrite in part replaced by chalcocite.

The hanging wall contact of the ore body was sharp and in places was marked only by a narrow clay selvage. The footwall contact was a wide zone of shearing between the massive sulfide and altered shale. Disseminated ore was locally present in the shale below the ore body where the impervious altered shale (No. 6) was absent or where faults permitted penetration by supergene solutions. Pyrite was in part replaced by chalcocite, but most of the chalcocite was apparently deposited independently of the pyrite.

All the ore bodies occurred within a 150-foot-thick stratigraphic horizon in the Rio Tinto formation where the beds were more broken and contorted than elsewhere in the formation. Stratigraphically above the ore beds is a thick persistent bed of quartzite. The shale bordering the ore body, particularly near the footwall, is altered to a schist containing dark-green chlorite. Several faults with a northerly trend cut the ore body, and minor displacements are numerous.

Genesis.—The faults cutting the ore body are regarded by Stephens as post-mineral, and therefore not of significance in the localization of the ore body as earlier suggested by Nolan. Exploration below the ore revealed no feeding structures. Possibly the greater crumpling of the shales of the "ore beds" is the result of shearing and fracturing, which gave channels for ore-bearing solutions; but no explanation is offered for the concentration of sulfide deposition at this particular locality and for its complete absence, as far as known, elsewhere within the Rio Tinto formation. The mine workings of the Rio Tinto mine are shown on plate 15.

Future prospects

Prospecting has probably eliminated the possibility of finding other outcrops of gossan that might lead to a replacement deposit similar to the Rio Tinto, but, as Nolan points out, lenses of copper ore that do not reach the surface may exist. Discovery of such lenses would be difficult. Nolan suggests that minor faulting may be a guide, but Stephens' observations render this doubtful. Perhaps zones of intense crumpling in the Rio Tinto formation