

Well-preserved fossils found at the Pride of the West mine were identified by T. W. Stanton as *Pseudomonotis subcircularis* Gabb, which is characteristic of the Upper Triassic. There is little doubt that the greater part of the sedimentary rocks of the range are of Triassic age. No intercalated Triassic lavas similar to those of the Humboldt Range were observed.

Lustrous clay slates form the most common "float" along the western foot of the range. Along Canyon Creek a few miles south of National the smooth clay slates strike north and dip 50°-80° E.

The sedimentary rocks are intruded and metamorphosed by at least five stocks of granodiorite or quartz monzonite, all of which are probably of post-Triassic age.

A small mass of intrusive diorite occurs on Winnemucca Mountain and is especially conspicuous on its steep eastern slope. A second much larger intrusive mass lies near Bloody Run Peak. A third mass is found in the southern part of the range north of Flynn station. A fourth and fifth stock lie near Rebel Creek and on Spring Mountain. None of these stocks was investigated in detail.

#### MINERAL DEPOSITS.

##### PRINCIPAL DIVISIONS.

The mineral deposits of the Santa Rosa Range, like those of so many other parts of Nevada, may be divided into two principal classes—(1) gold and silver bearing veins that occur in or near the Tertiary volcanic rocks and that are of Tertiary or possibly in part of Quaternary age; (2) gold and silver bearing veins that occur in the sedimentary rocks and in the post-Triassic granular rocks intruded into the sediments and that are probably of late Mesozoic age.

##### OLDER MINERAL DEPOSITS.

Though little work was done on the deposits that antedate the Tertiary lavas, a few notes may be given as to their general character. Such deposits are widely distributed through the older rocks of the range from Winnemucca Mountain to Canyon Creek, but the only places from which a large production has been reported is the Spring City camp, north of Paradise.

The deposits are quartz veins or, more rarely, replacement deposits in limestone or lime shale. The quartz is generally milky white and massive, not drusy, and in appearance is similar to that of the gold quartz veins of California. These veins carry both silver and gold, though the value of the gold usually exceeds that of the silver. Some of them have yielded placers which were worked at a profit.

There is little doubt that these deposits owe their origin to mineralization that followed the intrusion of granular rocks. The appearance

of samples of the ore examined suggests that the deposits were formed at intermediate depths and that they have been subjected to great pre-Tertiary erosion.

In the southern foothills of Winnemucca Mountain, at an elevation of 4,400 feet, the Pride of the Mountain vein was worked as early as 1868 for lead, silver, and gold. According to the data contained in "Raymond's Reports" the mine was worked between 1868 and 1877. The ores were first shipped to San Francisco but were later treated by stamping and roasting and by amalgamation in the Humboldt Reduction Works at Winnemucca. The ore is said to have had a value of \$40 to \$100 a ton. Several other veins in the vicinity are mentioned but were evidently not worked extensively, as no figures showing production are given. The deposit is said to be a vein with northwest strike and northeast dip. The country rock is calcareous Triassic shale.

On the west side of the mountain, at an elevation of about 5,975 feet, is the Adamson gold deposit, described on page 15. This is evidently a deposit of late Tertiary or Quaternary age. On the east side of the mountain, along a small intrusive body of diorite, there are several copper deposits containing oxidized ore, probably of contact-metamorphic origin and clearly belonging to the earlier series.

In the middle part of the Santa Rosa Range is the old camp of Spring City, 8 miles northwest of the town of Paradise. The district was discovered about 1868 and organized in 1873, and its mines were worked most actively in the early eighties.<sup>2</sup> It is reported to have produced metals to the value of several million dollars. The last important work was done in 1891, though in the last two years a few tons of ore have been shipped, and some tailings were cyanided in 1911 and 1912.

According to information obtained from Mr. R. S. Bolam, the formation consists of calcareous slate cut by dikes of porphyry which are said to be older than the deposits. East of this, according to report, there is a great rhyolite flow. There was a shallow oxidized zone containing chloride of silver, and below this some pyrite, ruby silver, and argentite were found. In depth zinc blende increased and the ore was of low grade. The ore contained both gold and silver and yielded from \$8 to \$20 in gold and \$10 to \$1,000 in silver per ton. Where barren the veins are wide and prominent, but where ore occurred they are narrow. There are two systems of veins, the first called the Paradise and the second the Bullion-Wildgoose. One stope in the Bullion-Wildgoose vein is reported to be 300 feet long, 300 feet high, and in places as much as 20 feet wide. The work was carried

<sup>1</sup> Raymond, R. W., Statistics of mines and mining in the States and Territories west of the Rocky Mountains.

<sup>2</sup> Burchard, H. C., Rept. Director of the Mint on the production of precious metals in 1883, pp. 515-529; also for 1884, p. 357.

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on mainly by tunnels, which reached depths of 600 to 700 feet below the outcrops. The proportion of gold to silver is said to have been greater at depth than near the surface.

Not having examined these deposits, I do not feel entirely certain that they were formed during the older period of mineralization.

On the west side of the range prospecting has been carried on at Rebel,<sup>1</sup> Willow, and Canyon creeks, the last only a few miles south of National. All these deposits are of the older series and are generally in slates.

Some prospecting was done on Rebel Creek in 1911. The Ohio claim is one of the earliest locations on the creek. This prospect was worked in 1884, according to the reports of the Director of the Mint. The veins of Canyon Creek lie in slate and are about parallel to the schistosity. They contain milky quartz, some siderite, and a little pyrite. The developments are insignificant.

On Pole Creek, about a mile south of the upper part of Canyon Creek, much gold quartz float was found in the early days and a 5-stamp mill was erected to treat it. The production was \$30,000, it is said. No vein was found.

Placer deposits that probably derived their gold from these pre-Tertiary veins were formerly worked on a small scale at the foot of the range on Willow Creek, about due east of Spring Peak.

#### TERTIARY MINERAL DEPOSITS.

During the early prospecting the deposits in the Tertiary lavas of the north end of the range appear to have been overlooked, though it is said that the veins on Buckskin Peak were known many years before the deposits of the National district were discovered. These deposits, found in 1907, will be described in detail in the following pages and are therefore only briefly referred to here. They are fissure veins, most of them narrow and of low grade, carrying a little gold and a few ounces of silver. They contain, in a drusy, fine-grained quartz gangue, small amounts of pyrite, zinc blende, and other minerals, but all carry stibnite in larger or smaller amounts, and at least one deposit carries cinnabar. In one of these veins was found the remarkable shoot of pale gold (electrum) which within four years yielded nearly \$4,000,000. The veins northward have a steep westerly dip and occur in rhyolite, basalt, and latite. There are no placers.

The lavas in which the veins occur are probably of Miocene age and the veins were doubtless formed by the action of ephemeral hot springs after the extrusion of a large sheet of rhyolite late in the period of volcanic activity.

On the western slope of Winnemucca Mountain, at an elevation of 6,000 feet, a remarkable deposit, which deserves special mention, was worked by W. G. Adamson in 1911. The rocks exposed on the western slope are dark, smooth, fissile slates, slightly altered by contact metamorphism, but they include also some calcareous slates. The general strike is northward, but the dip is very irregular. A mass of intrusive diorite is exposed on the east side of Winnemucca Mountain, its contact with the slates being near the top of the ridge on that side. The slates are cut by a few dikes of porphyry, which is probably related to the diorite.

There are several prospects in this vicinity, and some of them, about 150 feet higher up than Adamson's camp, contain calcite veins cementing irregular brecciated zones. These remind one strongly of hot-spring deposits formed near the surface. The veinlets are banded and drusy, the slates between them soft and yellowish.

At Adamson's camp a well-defined vein outcrops, striking northeast and dipping steeply northwest. It is traceable for a few hundred feet. The vein filling, which is several feet wide, consists of granular calcite distinctly banded and stained yellow by limonite. At the outcrop back of the mine office it contains rather plentiful specks of cinnabar. In composition, appearance, and structure the vein recalls strongly a hot-spring deposit. An assay by Prof. E. E. Bugbee gave a trace of gold and one-third of an ounce of silver to the ton.

The northeastern part of the vein beyond the mine office appears to be faulted to the southeast with an offset of about 200 feet. The discovery in this part is an outcrop consisting mainly of brecciated slate filled with drusy quartz. This quartz vein is probably the continuation of the calcite vein. A tunnel 30 feet below the top of the outcrop disclosed a well-defined vein 10 feet wide, striking northeast and dipping 60° NW. A narrow and persistent streak along the footwall contains barite with quartz. Rich ore with pale native gold was struck in the tunnel near the floor and is contained in a narrow streak which, with clay and limonite, also lies along the footwall. The rich ore did not extend to the roof of the tunnel, but within a short space coarse gold was extracted to a value of \$8,000. This was in 1911. The developments since then have been continued and a small mill has been erected. The statements in the reports on the metal production of Nevada in the Survey's "Mineral Resources of the United States" do not indicate that any large ore shoot has yet been encountered.

The high-grade ore continued below the tunnel level and was taken out by underhand stoping. In some places the gold formed an almost continuous sheet along the footwall. At other places the pay shoot widened and contained ore of milling grade. A small pan mill was

<sup>1</sup> Burchard, H. C., Rept. Director of the Mint on production of precious metals in 1884, p. 357, 1885.



installed in 1911, the same pan in which the first high-grade ore from the National mine was milled.

The rich ore, when examined closely, is seen to consist of fine-grained drusy quartz in which the gold is contained in closely massed rodlike or clublike forms, with a tendency to dendritic development, not greatly different from the mode of occurrence at the National mine.

A tunnel 50 feet below the upper tunnel did not cut the vein, but ran into what seems to be an east-west cross fracture faulting the vein. This vein also contained some quartz and a little gold. Very likely, however, this cross fracture antedates the mineralization. There is a marked difference between the calcite-cinnabar filling in the southwestern part of the vein and the quartz-barite-gold filling in the northeastern part, so that these different parts may have been filled during successive stages of the mineralization. That the whole mineralization at this place is due to the action of hot springs at points very close to the surface can scarcely be doubted.

There are no volcanic rocks in the immediate vicinity, but there are several basalt flows near Winnemucca, and hot springs break out along Little Humboldt River, above that town.

#### METAL PRODUCTION OF SANTA ROSA RANGE.

Accurate statistics are unfortunately not obtainable regarding the production of the mining districts of the Santa Rosa Range. The production of Humboldt County given in the later reports of the United States Mint and the United States Geological Survey conveys little information, because the usually heavy output of the districts of the Humboldt Range forms part of it. The production falls in three well-defined periods, corresponding to the development of three districts.

The earliest period, from 1868 to 1880, corresponds with the working of the Pride of the Mountain mine, in the Winnemucca district. This mine may have yielded \$1,000,000, but this figure is based upon no accurate data.

The next period, from 1880 to 1891, corresponds to the working of the rich veins of the Paradise district, and this production is said by local authorities to have amounted to several million dollars. No accurate data of total production are available. According to the report of the Director of the Mint for 1883, the Bullion mine produced in that year about \$400,000 in silver and gold. From January, 1879, to December, 1883, the Paradise Valley Mining Co. produced \$366,735. From August to December, 1883, the production of this company was \$72,733 in silver and \$9,260 in gold. In 1884, according to the same authority, the production of the Paradise Valley

Mining Co. was \$215,259. In 1887 the same production was \$126,000; in 1888, \$16,963; in 1889, \$40,054; in 1890, \$9,264. If these scattered figures give any indication of the real production, the total output has probably not exceeded \$3,000,000. Operations ceased in 1891. Since 1911 the reports of the United States Geological Survey indicate an awakening from the dormant stage. A production of \$2,313 was recorded in 1912. The production from the Rebel Creek and Willow Creek districts is not known; the former has yielded a little gold and silver ore, and placers were worked in the latter.

The last period of metal yield in the Santa Rosa Range began in 1909 with the discovery of the National bonanza in the hitherto unproductive northern part of the range. Unfortunately, though the production of Humboldt County is known, no figures showing the output of this mine separately could be given in the statistics collected by the United States Geological Survey because of the rule against disclosing individual production. From the data given in the Survey's "Mineral resources of the United States" from 1910 to 1913 and from some hints vouchsafed in the text it may be inferred that the production of the National vein was at least \$80,000 in 1909, \$1,000,000 in 1910, \$500,000 in 1911, and \$600,000 in 1912. This would amount to \$2,180,000, but there are reasons for believing that this is fully \$500,000 short of the actual production. On the other hand, it has been stated that the production to November, 1910, was \$1,700,000, and the current reports in the district assign a production of about \$3,000,000 or \$4,000,000 to the mine up to the end of 1912. Certain it is that during the whole period of working more or less ore stealing went on, and it is stated that the value of the ore stolen before the present company took hold of the property amounted to many hundred thousand dollars.

The total production of the mining districts in the Santa Rosa Range since 1869 is thus probably not less than \$7,000,000.

#### LITERATURE OF SANTA ROSA RANGE.

The literature on the Santa Rosa Range and the National mining district is scant. The following list is probably complete:

1870. Raymond, R. W., Statistics of mines and mining in the States and Territories west of the Rocky Mountains [for 1869], p. 193.  
Describes Pride of the Mountain vein, on Winnemucca Mountain.
1877. Hague, Arnold, West Humboldt region: U. S. Geol. Expl. 40th Par., vol. 2, pp. 737-738, 1877.  
Describes limestone, slate, and sandstone of Winnemucca Mountain; also diorite and syenite.
1883. Burchard, H. C., Report of the Director of the Mint on the production of gold and silver in 1883, pp. 525-529, Washington, 1884.  
Contains brief descriptions of several mines in the Santa Rosa Range.