The Bullfrog Mining District of Nevada.

By A. H. MARTIN.

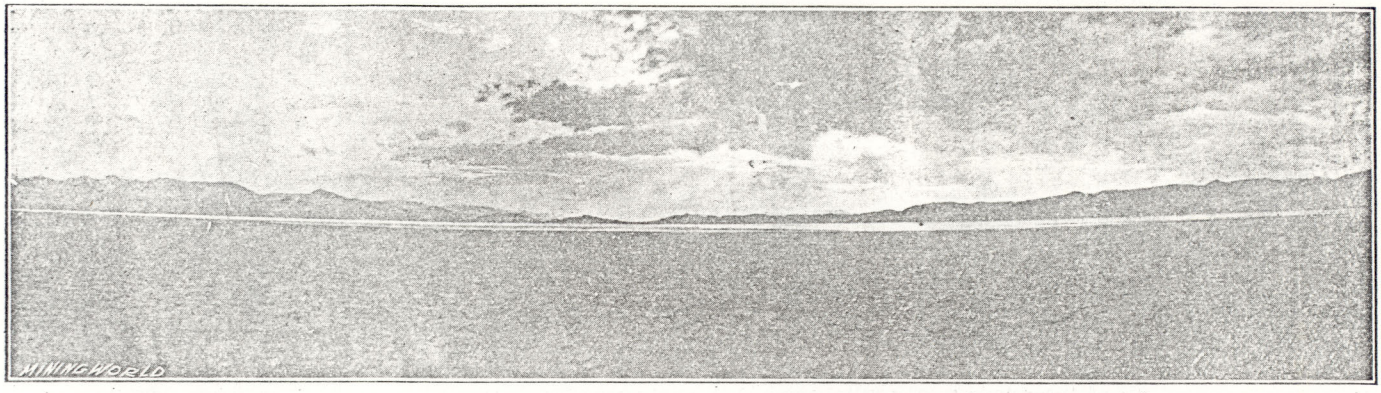
The Bullfrog district came into prominence August 9, 1904, when Frank Harris sunk his pick into the outcroppings of the Original Bullfrog claim and unearthed some of the green ore that was destined to make the district among the most famous in Nevada. Prior to this the district had been visited by many wandering prospectors but the bold ridges of rhyolitic ore had attracted little attention. The rich ore opened by Harris and associates on the Original Bullfrog and nearby properties attracted miners from Tonopah and Goldfield, and the Spring of 1905 saw the hitherto deserted region swarming with gold-seekers. Since that time the growth of the district has been steady, although the panic of 1907 brought operations on many properties to a standstill, and it was not until the present year that the numerous camps began to take on new life. There have also been several failures in the district, but this is attributed more to the inefficient understanding of the ore deposits, than to any fault of the properties themselves. During the boom days of 1905 and 1906 a dozen Bullfrog properties were selling at absurdly high prices, and when the crash came it had the inevitable result of shattering confidence in a number of meritorious properties.

The ore zone of the district has been generally proven for a distance of 15 miles long and 10 miles wide. In some places within this proven belt large areas of barren ground occur, but one or two mines have demonstrated the presence of ore bodies at considerable depth under the barren zones. The Montgomery-Shoshone has more conclusively proven the nature of the ore bodies than any other property, although developments in the Mayflower, Tramps Con. and one or two others have contributed materially to a more perfect understanding of the characteristics of the deposits. The veins are generally of large size, frequently running from 20 to over 100 ft. wide. Values generally range from $8 to $20 and upward, with occasional bunches of high-grade. The country rock is rhyolite with much of the high-grade occurring in talc. Fissure veins are common and numerous shoots display evidence of secondary enrichment. The ore is usually of a refractory nature, although numerous veins carry high percentages of free milling ore. The peculiar green ore that first brought attention to the district and gave it its suggestive name, has not been found to any extent outside of the Original Bullfrog and West Extension mines, and is usually associated with high-grade quartz.

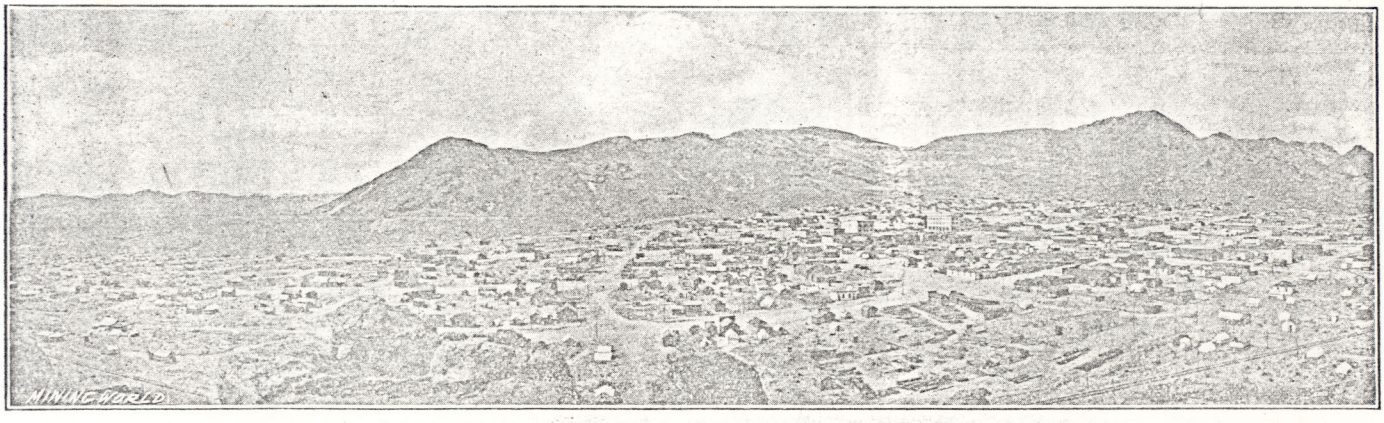
Water is obtained from scores of springs in the neighboring mountains, with numerous lines of pipe supplying mines and mills. In this respect the Bullfrog enjoys a decided advantage over the majority of southern Nevada districts. Timber is somewhat scarce, but excellent transportation facilities enables timbers and supplies to be brought in at a comparatively low cost. The lines of railroad, the Las Vegas & Tonopah and the Tonopah & Tidewater, traverse the district, with several spurs reaching out to important mines.

During the boom days it became very easy to interest outside capital in Bullfrog promotions, and as a result wildcatting flourished. This had the effect of destroying a large measure of public confidence in the district when the panic came, but the progress now being made is the result of enterprise and demonstrated merit. At the height of the boom 1000 men were working on the numerous claims. At present it is estimated that 500 miners are employed between the Keane Wonder on the north, and the Aurora Bullfrog on the south. In 1908 the Bullfrog district produced approximately $1,000,000 in gold and silver, and the present year is expected to record in excess of $1,500,000.

The principal property of the district is that of the Montgomery Shoshone Con. Mines Co., owning 171,111 acres of mineral land, comprising the original holdings of the Montgomery-Shoshone, Shoshone Polaris and Crystal Bullfrog companies. The company also owns two millsites embracing 10 acres; 500 acres of agricultural lands in Oasis valley and



Death Valley as Viewed from Funeral Range.



Rhyolite, Nevada.

water rights with an aggregate flow of 500,000 gal. per day. The mill, pipe line and water rights are controlled by the Bullfrog Reduction & Water Co., a subsidiary corporation. The company is capitalized for 500,000 shares, par value $5.

The Montgomery-Shoshone is the principal and most extensively developed mine of the merger. The main shaft is a 3-compartment and 700 ft. deep. At the 600-ft. level a heavy flow of water was encountered, while the talc ore has become more heavily impregnated with sulphides. Cutting through the property is a vast zone of crushed ore irregularly traversed by seams of quartz and talc. A huge fault dike borders the general course of the zone and breaks the formation badly. The length of this ore zone remains undetermined, but it has been quarried in the center for a width of 250 ft. This is known as the Montgomery-Shoshone "glory hole," which has attracted so much attention from geologists and mining engineers. Some of the richest ore is found in the talc gangue. All of the ore lies south of the basalt fault, which is clearly defined at this point. In the glory hole the ore is quarried and sent to the mill direct. This ore averages about $8, and is produced at a very low cost. Developments in the shaft have proven the ore bodies uncovered in the glory hole to a depth exceeding 500 ft. besides opening several distinct veins of higher grade quartz. The shaft is sunk to the north of the glory hole and levels run to intersect the ore bodies.

The Montgomery-Shoshone shaft is equipped with a Hendrie & Bolthoff double-drum geared hoisting engine, with 12-in. cylinders and 16-in. stroke. It has a speed of 600 ft. per minute, and with the single cages employed has a capacity of 300 tons per 16 hrs. A Chicago Pneumatic Tool Co. compressor drives 10 3-in. drills. Steam power is generated by two 100-hp. Heine water-tube oil-burning boilers. Electricity is received for the mill from the Nevada-California Power Co.'s plant at Bishop, the contract calling for 300 hp. per day for a period of five years.

South of the glory hole the formation is more regular and a series of parallel southerly veins have been demonstrated. These veins have been cut at varying depths, and are among the richest yet opened. Further west the Polaris fissure vein has been developed to some extent by a shaft, and considerable ore exposed. At the present time it is estimated that the gross value of the ore exposed in the various workings will exceed $1,000,000, while systematic developments are constantly augmenting the supply. The estimated value of the developed ore ranges from $10 to $11 per ton.

As the ore is received from the mine it is crushed to a maximum size of 1½ in. by two 13 by 24 Blake jaw crushers, and elevated to storage bins. It is next passed through a series of 14 by 42 Traylor rolls, reducing through a ½-in. punched steel screen. The undersize goes to the next set of rolls, same size and type as the first battery, while the oversize is returned to the first rolls for re-crushing. The last battery crushes to 6 mesh, the oversize being returned for re-grinding.

The discharge passes to a battery of fine-grinding Traylor rolls and two Chilean mills. The mills and rolls handle about 75 tons of material per 24 hrs., and all ore has to pass a 40-mesh Tyler double crimped screen. Crushing is performed in cyanide solution. The pulp is delivered to two Dorr classifiers, dividing into concentrates, sands and slimes.

Concentrates are fed to a 4 by 9 Allis-Chalmers tube mill and ground for 24 hrs. Upon discharging the pulp goes to five 12 by 16 cone tanks where it is kept in agitation by compressed air fed through an ordinary ½-in. pipe. Extraction ranges from 97 to 99.57%.

The sands from the Dorr classifiers pass to seven Wilfley tables, and thence to a battery of collecting tanks. It is then elevated by means of a Blaisdell excavator, Robins belt-conveyor and Blaisdell distributor to the storage solution tanks. Strong cyanide solution is added and the sands kept in action four days. It next passes to the weak-solution tanks, where it remains for six days.

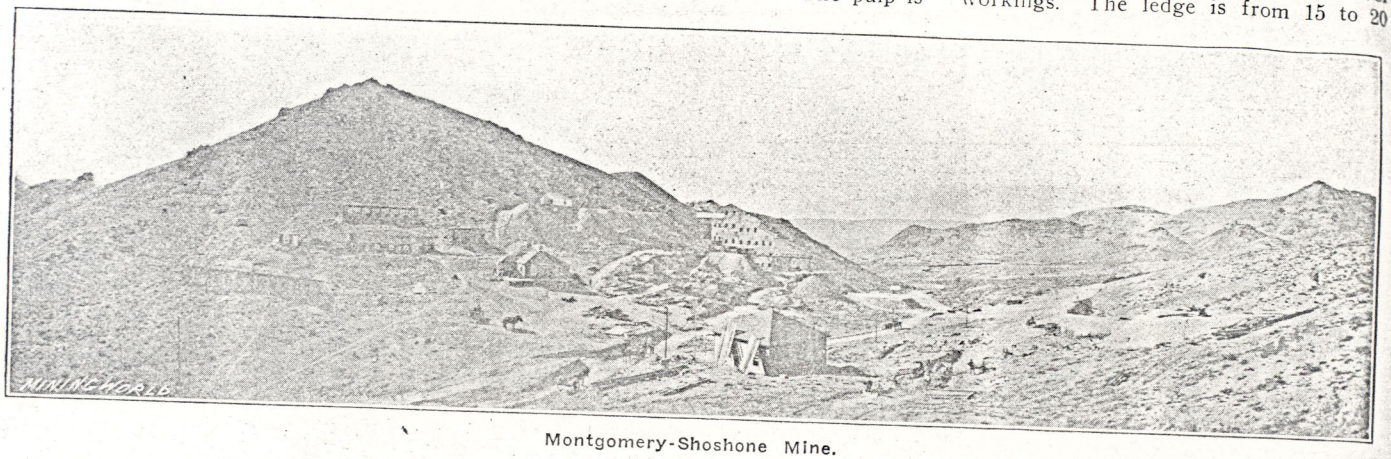
The slimes are received from the classifiers by 10 Frue vanners and delivered to the collection tanks. From these it passes to a Trent agitator which keeps the pulp in constant motion for 8 hrs. It is then transferred to the settling tanks and the solution decanted. The final treatment consists of the delivery of the slimes to the filter department. This consists of one press of 40 Blaisdell leaves and two presses of 50 Butters leaves each. The solution is precipitated in 10 iron zinc precipitating boxes. The ordinary zinc process is used. The extraction runs from 89 to 90%.

Milling costs run about $2.25 per ton, the total cost of developing, mining and milling being placed at about $5 per ton. The ore runs about 12 oz. silver to one of gold. At the present time the mill is crushing about 6000 tons of ore per month, and the annual profits of the company will approximate $226,000. Tests are constantly being carried on in an endeavor to still further lower milling costs. John G. Kirchen is general manager of the company, and E. M. Kirchen is in charge of the mill. Under the latter's care the percentage of the extraction has been materially increased and operating costs reduced. The milling plant was built by the Traylor Engineering Co.

The Mayflower Bullfrog Con. Mines Co. operates the Mayflower group of 11 patented claims, in the Pioneer section of the district. This property has been developed to a depth of 500 ft. by the Mayflower shaft, with most of the ore coming from the 200 and 300-ft. level workings. The ledge is from 15 to 20 ft. wide, with values ranging from $15 to $50. Below the 300-ft. level strong shoots of good-grade ore have been opened, and are at the present time receiving attention. The shaft is equipped with a 30-hp. gasoline hoist and a 100-hp. Westinghouse gas engine, operating a 10-drill Ingersoll-Sergeant compressor.

The mill consists of five stamps, amalgamating plates and a small cyanide annex. It is intended to add 15 more stamps. Water for the mill is pumped from the 500-ft. level of the shaft, where a strong flow has been encountered.

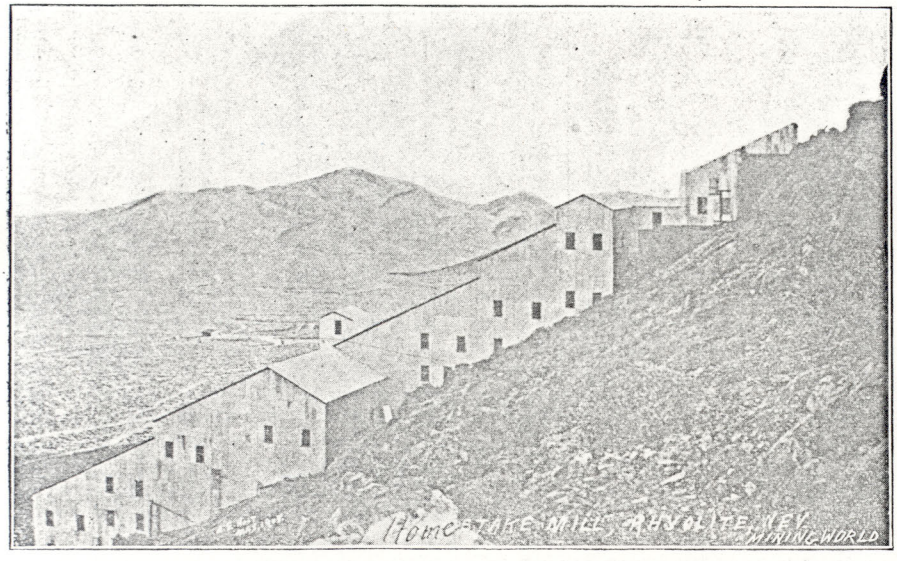
The Tramp Con. Co. controls the Denver, Eclipse and Tramp holdings, and has performed approximately 9000 ft. of development work. The company is confining activities to the Eclipse, where a 400-ft. shaft has been sunk, and several bodies of promising ore tapped. The crosscut tunnel has intersected a series of veins carrying good gold values, and it is intended to drive drifts from the shaft to cut these bodies at depth. Leases are operating extensively on the Denver and Tramp estates, and shipping steadily. Several narrow seams of bonanza ore have been opened on the Denver, and the main Denver ledge has been opened for a distance of 600 ft. Overbury & Mc-



Montgomery-Shoshone Mine.

Mahon recently secured a long-term lease on a section of the Tramp and will extensively develop the Eclipse and Hobo veins. They have already opened up considerable ore, which consists of gold bearing silicified rhyolite, and have made arrangements for the early erection of a 10-stamp mill and cyanide plant.

The Homestake-King mine is at present idle, but it is understood that the owning company is considering the resumption of activities. The mine is developed to a depth of 500 ft. with milling ore opened on the bottom level. The vein runs from 10 to 23 ft. wide, with most of the development above the 300-ft. level. On the 400-ft. level some good-grade ore was in sight at the time of suspension of activities. Values range from $5 to $20, with the average running about $8. The mine is equipped with a 40-hp. gasoline hoist, 8-drill compressor and gasoline engine. It is understood that in the event of resumption a new 600-ft. shaft will be sunk.



The Homestake Mill at Rhyolite, Nev.

The Homestake-King mill embraces 5 batteries of 5 stamps, each weighing 1050 lb., and dropping 100 times per minute. The ore was reduced to 18-mesh in the mortars, and passed with water over silver-plated copper amalgam plates. The pulp then passed to tube mills, from which the slimes were sent to vacuum filters, and the sands to leaching tanks. The extraction varied from 92 to 95%. The mill was built and installed by the Colorado Iron Works within six months after the designs were decided on.

The Montgomery Mountain Mining Co. controls the Three Peach, Polaris Fraction and Black Bull claims, adjoining the Montgomery-Shoshone mines on the west—a total of 63 acres. At present work is concentrated on the Three Peach where a shaft is going down to explore the basalt-rhyolite contact, on which occurs the glory hole deposits of the Montgomery-Shoshone. This property has not been developed to any extent, but such work as has been performed indicates that extension of the ore bodies in the Montgomery-Shoshone traverses the holdings of the Montgomery Mountain. The company is controlled by Samuel Newhouse.

Among other active properties in the Bullfrog district are the National Bank, Original Bullfrog, Gold Bar, West Extension, Bullfrog Mohawk and numerous others. In a majority of cases lack of ample capital is holding back work, while the absence of adequate milling facilities is also keenly felt. As much of the ore is too low-grade to permit of shipment to the smelters, the operators are unable to operate to any extent unless milling facilities are immediately convenient.

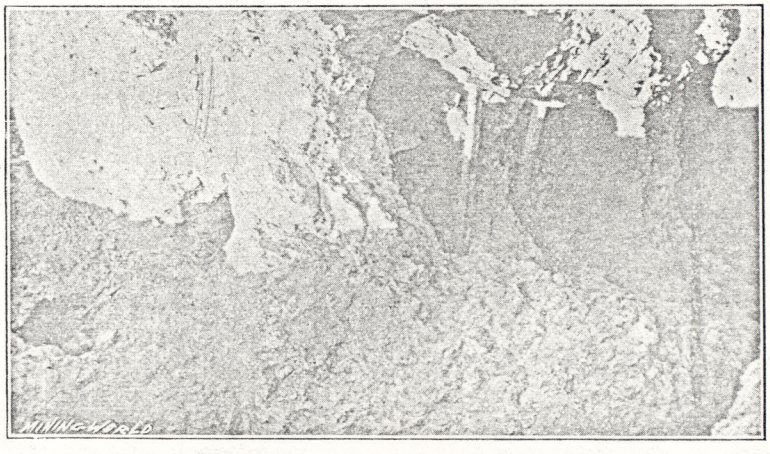
In the Pioneer section, which was the scene of considerable excitement in the early part of the present year, litigation among the owners of the principal properties have greatly restricted developments. From the Pioneer group several car loads of ore ranging $63 to $5500 per ton were sent out from the main vein above the 150-ft. level. This ledge averages 10 to 15 ft. wide. Just as the property was commencing to push developments and maintain heavy shipments, difficulties occurred with owners of adjoining properties, and it has only been within the last few weeks that operations have been resumed. Indications for the development of a valuable producer are excellent and it is probable that a milling plant will be early provided.

Although lying in Inyo county, California, the Keane Wonder mine is geologically and geographically in the Bullfrog district. The property is located in a narrow canyon leading out of Death Valley, and during the summer months the heat is at fever pitch. The property embraces 22 claims. The ore bodies are of enormous extent and are mined by the glory hole process. The ore occurs in blanket-like lenses with three distinct bodies opened. A shaft is going down to develop the mine and a 5-drill compressor has been installed to facilitate the work. Values range from $15 to $20.

The ore is trammed by hand cars to a central point from which it is dumped down the side of the hill 500 ft. into a chute. Here it is received by cars and trammed to the tramway terminal, 250 ft. distant. The tramway from mine to mill is nearly a mile long, and rises nearly 1000 ft. in covering the distance. The altitude of the mill is 1600 ft. The materials include 85,000 ft. of timber, 50 tons of rope, wire, etc., and was furnished by Leschen & Sons Rope Co. of St. Louis. The tramway is supported by 11 towers and one break-over station. The highest tower is 30 ft., the lowest 18 ft., while the longest span is 1200 ft.

The ore bins at the upper terminal have a capacity of 100 tons. Before loading, the ore is reduced to 1½-in. by a 5 by 10 grizzly and fed to a 9 by 15 Blake crusher, operated by power from the tramway. The buckets have a capacity of 600 lb., and are loaded automatically from the storage bins. A 13-hp. gasoline engine increases the power of the tramline. The engine is so arranged that it can operate the crushers independently of the tram, while the tram may also be operated independent of the engine.

The tram buckets unload automatically into the mill bins, which have a capacity of 200 tons. The ore is fed automatically to 20 stamps, and amalgamated over heavy copper plates covered with 2 oz. of silver to the square foot. The sands and slimes are treated in a cyanide plant of 200 tons capacity. The capacity of the mill is from 75 to 80 tons per day.



The Montgomery-Shoshone Glory Hole.

The extraction amounts to about 95%. In the summer months amalgamation is difficult because of the intense heat, and values show a perceptible falling off. Homer Wilson is manager. The main offices are at Rhyolite, the supply center and metropolis of the Bullfrog district.

Rhyolite was laid out in the early spring of 1905 and soon became the principal town. It is reached by the Las Vegas & Tonopah and the Tonopah & Tidewater railroads and is one of the substantial commercial centers of the new southern Nevada. The town is well supplied with pure water and is electrically lighted. Social and religious institutions are flourishing and the town shows much prosperity.