The Engineering and Mining Journal

VOL. LXXXVIII. NEW YORK, SEPTEMBER 18, 1909. NO. 12.

Notes on the Pioche Mining District, Nevada

Operations in the Past Were Generally Unsuccessful Owing to High Cost of Treating the Ores. Renewed Activity Expected

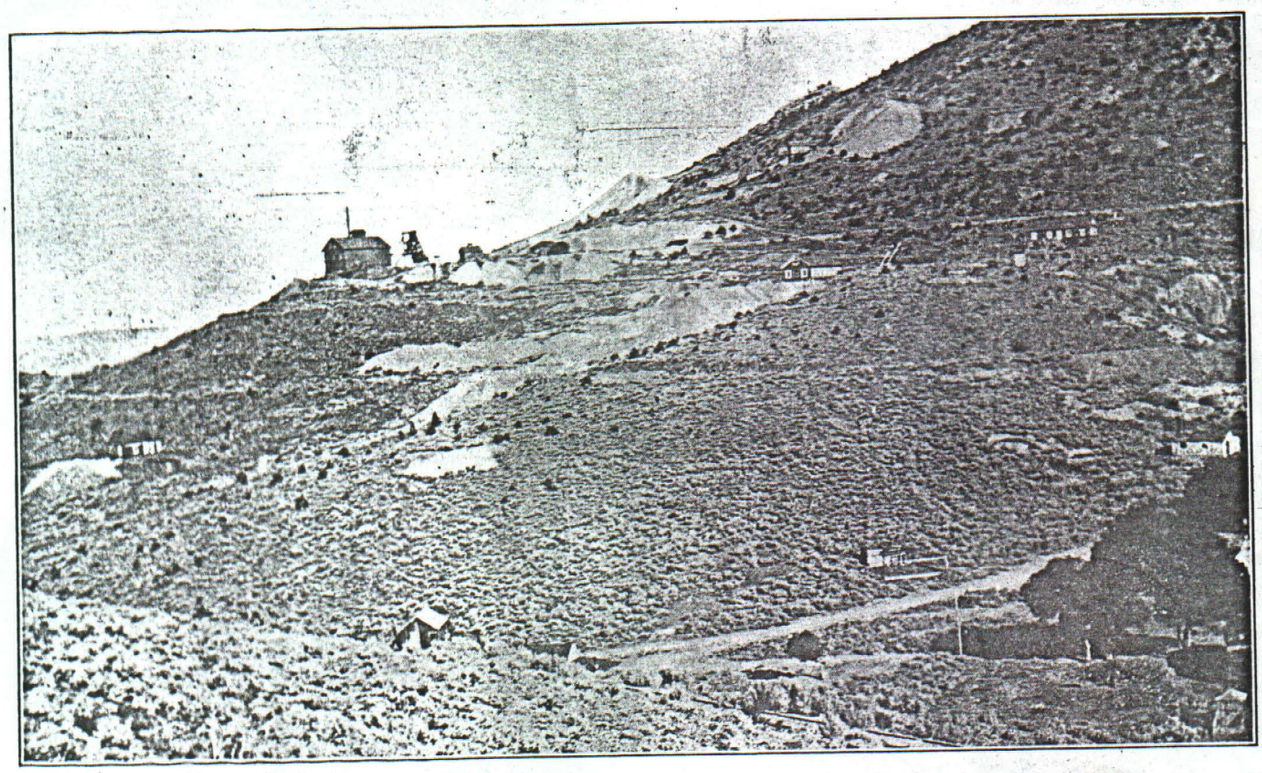
BY S. F. SHAW*

The historic mining town of Pioche is situated in the Ely Mining district, Lincoln county, Nev. It is the county seat and has a population at present of about 1500. The surrounding camps will probably swell this to 2000.

The locust trees lining the streets give the town a rather pleasant appearance. The climate in summer is not uncomfortable and the winter months are not severe, although there are frequent snow-falls.

The elevation of Pioche proper is about 5800, while the adjacent hills rise 600 ft. above the town.

There is no timber worth mention, the only growth being a species of scrub pine. The water supply for the town and mines is piped from springs in the Highland range, about 7 miles to the southwest. The town lies in the Pioche mountains, a range extending in a southeast-northwest direction about 15 miles with an average width of 1 mile, lying between Duck valley on the north and Meadow valley on the south. Mt. Ely is the highest point, reaching an elevation of about 7150 ft. To the northwest lies the Ely range, to the southwest the Highland range, and to the northeast and southeast lie respectively the Cedar and Mormon ranges.



MINES ON EAST END OF MEADOW VALLEY VEIN

140 Miles from Railroad Till 1905

Until 1905 the nearest railroad station was Milford, Utah, 140 miles distant. In that year the Salt Lake road was extended through Caliente, about 28 miles distant, and in 1906 a branch of this road was built north from Caliente to Pioche, placing it 352 miles by rail from Salt Lake City and 485 miles from Los Angeles.

The earliest recorded discovery of mineral was made in 1862 by soldiers under General Conner. In 1863 ore was found by some Mormons, and in 1864 several claims were staked off. It was not until 1868, however, that any important work was done. In that year F. L. A. Pioche employed Charles E. Hoffman to purchase some claims which formed the basis of the Meadow Valley Mining Company, soon afterward organized. Other claims were soon acquired and added to the holdings of the company, giving it a length of about 2500 ft. along the principal vein.

Soon afterward Wm. H. Raymond and John H. Ely entered the camp and organized the Raymond & Ely Mining Company which became the most important producer of the district.

Ores Milled on the Ground

Owing to the remoteness of the district, it became necessary to treat a large part

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of the ore on the ground. Raymond and Ely first installed a second-hand 5-stamp mill at Bullionville, near Panaca, and treated the crushed ore by amalgamation in pans and settlers. These stamps weighed 750 lb. per head and treated a total of 25 tons daily at a cost of $30 per ton, netting a profit of $90 per ton. Three large mills were built at Bullionville.

In 1872 a narrow-gage railroad was built to Bullionville reducing greatly the cost of transportation. About the same time the Meadow Valley company erected a 20-stamp mill at Dry Valley, about 10 miles east of Pioche, introducing the Washoe process then in use on the Comstock lode. The erection of other stamp mills followed.

Other processes besides amalgamation were also tried at later dates. Lixiviation was employed to some extent. At Bristol, about 20 miles northwest, a smeltery was built to treat the ores of that camp. All of these operations meant much to the district and the population of Pioche approached the 10,000 mark.

Renewed Activity Expected

In 1875-76 as depth was reached, the ores became impoverished. In the Meadow Valley shaft No. 3 water was struck at a depth of 1314 ft. on the incline, and the pumping problem became a serious one as further depth was attempted. In 1876 the failure of the Bank of California shut off all funds for further development work and the principal mines suspended operations.

In 1890 work was resumed, a narrow-gage railroad to Jackrabbit was built, a smeltery erected and Pioche once more began to assume the role of an important mining camp. However, the work done did not meet with the anticipated results and, with the decline of the price of silver in 1893, it again took on the appearance of a deserted camp.

In 1906, new capital became interested in the camp, and development at Jackrabbit, and also in the limestone on the south side of the town, is giving encouraging results. A railroad from Pioche to the south side is projected, and some rumors are heard of a smeltery to be built soon.

Production, Past and Present

The gross production of the properties in the district has been variously estimated at from $16,000,000 to $40,000,000. Probably $25,000,000 would cover the total production to the present time of those properties situated in Pioche and the immediate neighborhood. The mines along the porphyry dike are said to have yielded about $5,000,000, although no reliable figures touching on the distribution of this production are at hand. In the *Sch. Mines Quar.*, July, 1906, tables are given by Prof. Fred J. Pack, which were taken from the Daily Stock Report Assessment List, San Francisco, Jan. 7, 1876. From these tables it is seen that only two companies had, until 1876, paid an excess of dividends over the amount of assessments levied, and this amount, $2,475,000, is about 18 per cent. of the the gross production of these two companies. The total production until 1876 was $15,485,500. Dividends amounting to $4,385,000 had been paid, and $5,482,900 assessments levied.

During the early years of the camp the cost of mining and milling was high and the extraction low, hence it is not to be assumed that the same grade of ore, or for that matter a much lower grade, would not now yield a profit. An accompanying table, also given by Professor Pack, will show the high costs that prevailed in 1870-1876.

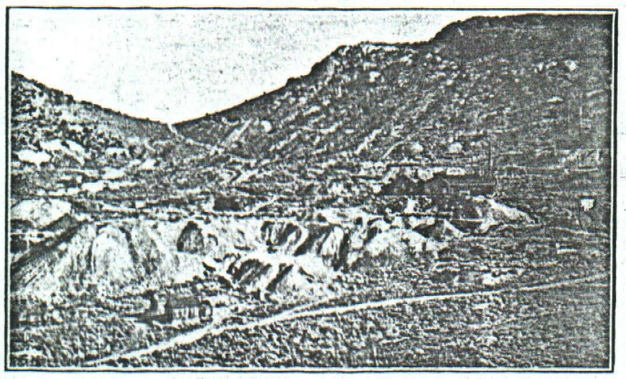
In 1875 the average yield of the Raymond & Ely ores was $52.36 at a cost of $45.10 for extraction, treatment, etc.

At the present time the Nevada-Utah Mines and Smelter Corporation is shipping about 150 tons of low-grade fluxing ore from Jackrabbit, averaging about $10 per ton. The Prince, on the south side, and the Mendha, about 6 miles southwest of town, are also making small shipments. The Prince is prepared to ship a largely increased tonnage as soon as the railroad is extended to that side of the range.

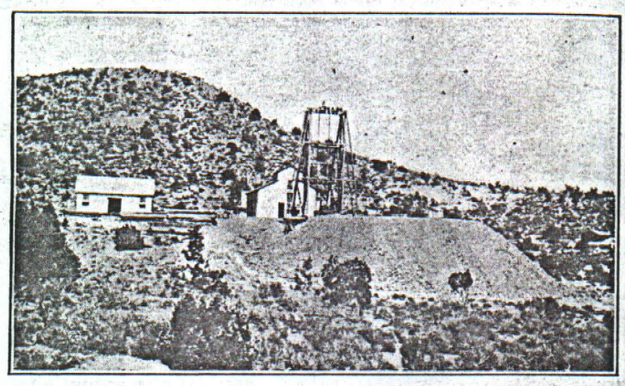
Geology

The Pioche mountains consist of an anticlinal fold with its axis extending from east to west, the strata of which consist of an underlying layer of Cambrian quartzite covered by a layer of shale about 400 ft. thick, which, in turn, is overlaid by a layer of limestone about 1400 ft. in thickness. A thin layer of shale of varying thickness is also noted in the limestone. The thickness of the quartzite is unknown, but it cannot be less than 1500 ft., as the Raymond & Ely shaft penetrates it for that distance.

Just south of the town the quartzite has been thrust up between two parallel faults, bringing it into juxtaposition with the shale on the north and south. It towers several hundred feet above the shale which dips away to the southwest from the central quartzite core at an angle of about 35 deg. It is in this upthrust block of quartzite that the Raymond & Ely-Meadow Valley vein, containing the rich orebodies, was first discovered.



WEST END OF MEADOW VALLEY VEIN



PIOCHE KING MINE

Dikes an Important Feature

After the faulting which raised the quartzite to its present position took place, there followed an intrusion of a quartz-rhyolite dike averaging about 75 ft. in thickness. This dike, generally known as the Yuba, strikes approximately magnetic east and west, cutting through all the sedimentary strata and dipping about 80 deg. to the south. In the neighborhood of the Yuba East mine this dike splits, one branch extending in a southeasterly direction, the other disappearing from sight. At the Alps mine, about 1 mile east, a porphyry dike is cut in the lower workings, and, as the shaft is in line with the northeast branch of the dike, this is supposed to be its continuation.

In a westerly direction it continues

through the Yuba East, Yuba, Currency and Mazeppa, and then splits again. One branch comes up through the shale and lime and runs lengthwise through the Alberta claim of the Ohio Kentucky company. The other continues westerly through the Raymond & Ely ground constituting the Independent vein (owned jointly by the Nevada-Utah and Ohio Kentucky companies). This latter fork is found only in the quartzite, not coming to surface through the shale and lime.

A dike of the same character is encountered in the Abe Lincoln tunnel about 2 miles southwest, and in the West Yuba and Fargo claims in the lower divide about 4 miles west of Pioche. There are also outcrops of an igneous nature at intervals both on this and on the other side of Stampede gap, and, as they are all said to line up with the Yuba dike, they are thought to be along the same intrusion.

In nearly all of the outcrops the component minerals of the dike are much decomposed with the exception of the original quartz crystals, which remain unaltered. The decomposition is also found to extend to the deepest workings. However, undecomposed material is encountered in the Abe Lincoln tunnel, and on the 800-ft. level of the Yuba East fresh specimens of a reddish appearance and showing large quartz phenocrysts have been taken out.

In some of the Yuba East workings the decomposed dike material is found to have minute pyrite crystals disseminated through it. In this mine the dike is broken up into an extensive series of transverse fractures which, from observations so far made, could be explained by contraction fractures formed during the cooling of the intrusion. On both walls of the dike movement has taken place, leaving behind a clayey gouge parting between the dike and the quartzite.

Fissures in the Quartzite

The quartzite is broken up into blocks by a series of fissures and cross-fractures. The Raymond & Ely-Meadow Valley ore deposits were found in the largest of these fissures so far discovered. This vein strikes east and west and dips about 70 deg. to the south, and maintains an average width of 2 to 4 ft., narrowing down in places to a mere seam, and widening out in others to 9 or 10 feet.

This vein, being less inclined than the Yuba dike, approaches it in depth, and if the same inclination were maintained throughout would meet the dike at a depth of about 1500 ft. The strike also being different causes the vein to intersect the dike west of the Lightner shaft.

The vein can be traced from its approximate intersection with the dike for a distance of 1300 ft. to the east where it divides into two branches at an angle of about 20 deg. to each other. The northeast branch extends about 1000 ft. to the Pioche shaft, a short distance beyond which it again branches and breaks up. The southeast branch continues beyond the Burke shaft, where it soon loses it identity.

The sequence of events as given by Professor Pack is as follows: (1) Anticlinal movement and shearing; (2) deposition of the bedded deposits; (3) breaking down of the anticlinal fold; (4) intrusion of the Yuba dike; (5) deposition of fissure veins and deposition on the dike contact; (6) minor cross-fissuring.

The Mines on the Quartzite Fissure.

Along the quartzite fissure the principal mines are the Hermes, Raymond & Ely, Meadow Valley No. 3, Meadow Valley No. 5 and Pioche. Also the Washington and Creole and Burke shafts which are located on the southeast branch of this fissure.

The Lightner shaft of the Raymond & Ely mine was started in the shale, and, on sinking a distance of about 100 ft., struck the large Raymond-Ely "bonanza" out of which the greater part of the ore was extracted. This body was about 400 ft. long at the 5th level, was almost continuous from the surface to the 8th level and varied in width from 1 to 4 ft. Below the 8th level the grade of ore deteriorated. At a depth of 1214 ft. the Lightner shaft encountered the water level and was compelled to install a 10-in. Cornish pump in order to reach greater depth. This level was extended west about 2100 ft., and at a point about 1400 ft. west of the shaft a winze 300 ft. in depth was sunk on the "black ledge," opening up a large body of lead and zinc sulphides. This vein is the westerly continuation of the north branch of the Yuba porphyry dike, the best streak being found on the north contact of the porphyry and quartzite.

The Meadow Valley No. 3 was sunk 1314 ft. on the incline before the water level was reached and was then continued to 1375 ft., at which point sinking operations were discontinued on account of the shutting down of the Raymond & Ely pumps which had previously drained the Meadow Valley. Considerable low-grade ore was encountered below the water level, the grade seeming to increase with depth.

The Burke mine was the first located and its vein was followed from the surface to a depth of about 300 ft. The vein in nearly all of the mines continued strong at depth but the orebodies became too greatly impoverished to work. Shafts were also sunk on cross-fissures extending between the main fissure and the dike, among the principal ones being the Williams, Desdemona, Huhn & Hunt, Chapman, and Arkansas.

Mines on the Dike.

The principal mines along the Yuba dike are the Newark, Mazeppa, Currency, Yuba, Yuba East, and Alps. The Williams mine, mentioned as being on a cross-fissure, contains the south branch of this dike. The ores occur on both hanging- and footwalls of the dike, and also along what is known as the "middle vein," which is really a set of fractures paralleling the strike and lying wholly within the dike.

The Yuba mine workings reach a depth of 1300 ft. and consist of about 2700 ft. of shafts and raises, and 7500 ft. of drifts, making a total of about 10,200 ft. The ore extracted from this mine is said to have approximated $1,000,000.

In the Yuba East, immediately adjoining the Yuba on the east and connected with it by a drift on the 100-ft. level, about 1400 ft. of shafts and raises and 3500 ft. of drifts have been made. The depth of the shaft on the incline is 840 feet.

Mines on the Bedded Deposits.

The principal mines working on the bedded deposits are the Prince, Mendha, Abe Lincoln-Half Moon, Point and Ely Valley properties. The Pioche King, Golden Prince, Gold and Silver Prince and Demijohn are also properties exploiting these bedded deposits.

The Prince mine is about 3 miles south of Pioche on the Meadow Valley side of the Pioche range. The shaft has reached a depth of about 600 ft. on an incline of about 65 deg., and about 6000 ft. of drifting, crosscutting and raising has been done, opening up the beds and veins in a systematic manner for a distance of 600 ft. on both the north and south sides of the shaft. The entire workings are in shale and limestone, the beds of which strike about north and south and dip about 15 deg. to the east.

Here the bedded ore deposits replacing the lime were dislocated by a series of fractures into a system of step faults. This faulting was followed by a system of faulting producing a set of vertical fissures, two of which have been explored,

COST PER TON FOR MINING.

Year.	Company.	Extracting.	Prospecting and Deadwork.	Incidentals.	Total.
1871	Meadow Valley	$14.20	$5.71	$4.59	$24.50
1872	Meadow Valley	.....	.....	.....	38.55
1872	Raymond & Ely	.....	.....	.....	14.45
1873	Raymond & Ely	13.67	12.19	5.97	31.83
1874	Raymond & Ely	23.06	50.06	6.13	79.25
1874	Meadow Valley	22.19	48.87	.....	71.06
1875	Raymond & Ely	14.78	20.18	10.14	45.10

crossing the bed faults at an angle and breaking them up into a regular system of fault blocks. A series of cross-fractures can also be distinguished running between the two vertical fissures. The bedding planes, vertical fissures and cross-fractures all make ore composed of galena, anglesite, and cerussite, rich in silver and carrying some gold.

The shaft was first started on an immense body of low-grade manganiferous ore containing about 6 per cent. lead and 6 oz. silver. As depth was reached this body was found to run into and follow the bedded deposits. The vertical fissures were first discovered on the third level, and when followed upward were found to apex in the large body of manganese ore previously mentioned.

The Abe Lincoln-Half Moon workings are also on a bedded vein which lies between the shale and the limestone. The mineralized part is about 12 in. thick. The Yuba dike was encountered in these workings. At the Mendha mine a system of block faulting quite similar to that of the Prince mine is seen, with the bedded ore deposits occurring along the fault planes. The ores of this property contain more gold than is usual in the ores of the other mines.

Treatment of the Ores.

The first attempt in 1871 to treat these ores, then consisting for the most part of silver chloride and sulphide associated with low percentages of lead sulphate and carbonate, was by smelting. Owing to the low lead content the attempt was not a success. Later stamping, followed by amalgamation in pans and settlers, was tried, and on some of the ores gave as high as 60 per cent. extraction, while on other it fell below 40 per cent. The Washoe process was then employed wherein salt and copper sulphate were added to the pulp in the pans, and the extraction rose to 80 per cent. The amalgam so obtained contained a considerable quantity of lead which was separated by first straining through a sack in hot water, the lead passing through with the mercury. The mercury was then retorted from both the products and the lead and silver thus recovered separately. Lixiviation with "hypo" was also tried with more or less success.

At the Half Moon mine a small crushing plant was put in to handle about 50 tons per day. The product was run over tables and the tailings treated in cyanide vats. The extraction was low and the cost of treatment high, but the reason for this is apparent to one comparing this old plant with the cyanide mills of the present day. In 1890 the new smeltery built below Pioche was successful in treating the ores then mined, which contained more lead than formerly. These ores came largely from the Yuba dike and from the mines at Jackrabbit.

At the present time the ore developed consists principally of lead carbonates, sulphates and sulphide, carrying gold and silver. This ore is adapted only to treatment by smelting. Large bodies of ore, low in lead and silver, but containing an excess of iron and lime, have been developed and will provide the flux for handling the higher-grade and more silicious ores. As depth is reached it is quite probable that the ores will run into lead and zinc sulphide.

Wet concentration tests, obtaining a commercial degree of extraction, have yielded lead and zinc products which are said to have been of good grade.

I am indebted to E. L. Godbe for supplying some of the data herein used.

Practical Working of the Stamp Mill

By Algernon Del Mar*

The number of tons of ore crushed by a stamp mill in a given time depends upon the weight of the stamps, the hight of drop, number of drops per minute, hight of screen discharge, size and character of screen openings, the width of mortar at the discharge, the character of the mortar foundations, condition of wearing surfaces of shoes and dies and the number of hours the mill is at work. The last factor will be the subject here treated.

We see in a certain report that the mill has run 93.8 per cent. of the time. If we allow 25 min. a day for two brushings and 1½ hours per battery once a month for clean-ups, this will consume for a 100-stamp mill about 1400 stamp hours per month, or say 2 per cent. of the time, leaving 4.2 per cent. for repairs (3042 stamp hours), an average of four stamps hung up all the time. The idleness of these stamps entails losses besides that in crushing time from expenditures for repairs and wages for at least four men, unless the loss of time is due to causes outside of the mill proper. With a stamp mill as with other classes of work all necessary repairs should be well made. The time lost in doing a good job will in any case be repaid in the gain in running time.

A mill to attain its maximum capacity should be at work all the time except, of course, such time as is actually necessary for keeping the plates in condition for catching the precious metals, for the regular clean-up and for changing shoes about once every six months. This last item does not consume more than 15 min. per stamp twice a year and so is hardly appreciable. The dies need only be changed on clean-up days and it takes no more extra time than setting the tappets. There are many stoppages due to defects in construction and operation which may be lessened by careful and knowing management. Much loss of time is often occasioned by not having duplicate parts handy and by carelessness in making repairs.

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Important Details of Construction

Our mills of late years have gained in capacity as well as in running time on account of the greater weight of the stamps used, higher speed, better materials used in construction and improvements in the style of the several parts. There has been a retrogression in the adoption of iron guides of the usual individual cap type. These guides have made repairs more frequent because the stems working in the guides wear so that they become too small for the tappets to be set without shimming and excessive hammering, which destroys the tappet gibs besides wearing the patience of the millman. The play in the guides is often so great that shoes and bosses hit or the shoes wear unevenly on the dies.

It might be argued that worn guides should be immediately changed for new ones, but as a rule they are not and the millman must put up with them and the consequent breakages. Wooden guides are preferable to iron ones and wear for years if properly taken care of. When sectionalized they have given trouble and when in one piece (the cap) they cause loss of time in changing stems or tappets, for the whole battery must be hung up. However, there is no reason why sectional wooden guides fitting in a cast-iron frame should not be satisfactory. The Angelo Camp individual sectional guides are a very good type of iron guides. No bolts are used except for bolting the frame to the guide timbers, and the wearing parts are so inexpensive that there is no excuse for having loose guides. The stem works in a cylindrical casting about ½ in. thick, which castings may be split in two for the lower guides or for a burred (broken) stem in the upper guides. The cylinders fit in a truncated cone-shaped receptacle in the frame so that the cylinders are kept in place by gravity and the vibration of the battery frame. To change a stem or tappet the cylinders are forced up and the stem may then be taken out.

Feeders seldom cause loss of time. The expense and trouble due to pawl springs, as well as the time lost over a broken stem caused by a feeder not working and the battery running dry, may be obviated by the use of the Knight wheel in place of the usual friction wheel with pawls. This wheel is worked on the leverage system and gives a more constant and