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The Sheep Creek Gold Mining Camp*

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Introductory

THE recorded production of the Sheep Creek camp from 1900, when the Yellowstone Mining Company first put its mill into operation, to the present day is in excess of $17,500,000. Of this total, $2,500,000 can be attributed to the early period from 1900 to 1916, at which time increased costs of labor and material due to the Great War forced abandonment of any operations on a large scale for a number of years. Since the camp was revived in 1929, at which time the Reno mine started large-scale operations, and the early thirties, when the increased price of gold induced the commencement of operations on other properties in the district, total gross production has been in excess of $15,000,000. In addition to the above totals, intermittent shipments were made by lessees and small operators, principally during the period of inactivity from 1916 to 1929, but no records of this production are available.

The Sheep Creek camp would rank fifth in the province behind Rossland, Portland Canal, Bridge River and Hedley camps in gross gold production, but because of relatively inexpensive mining and milling costs, would occupy a more prominent position in regard to total dividends paid.

Operating mines at the present time include Reno Gold Mines, Gold Belt Mining Company, Kootenay Belle Gold Mines and Sheep Creek Gold Mines. Each one of these companies, with the exception of Kootenay Belle, represents a consolidation of several smaller properties, all of which were in existence for a number of years prior to 1929. These four companies, at the present time, own, or hold options, on practically all the important claims in the district with the exception of a very few claims and fractions still held by private owners.

Old Reno mine, looking north across Fawn Basin.

Early History (1900-1916)

Yellowstone

This, the oldest mine in the district, was located in July 1896 near the confluence of Wulf and Sheep Creeks. Development began late in the same year, and in 1900, a 10-stamp mill using amalgamation only, was erected to treat the ore developed. By the end of 1901, all the known ore in the Yellowstone had been developed and mined, the vein proving unproductive below the third level where oxidation ceases. During this time, 16,987 tons of ore were treated, yielding 5,912 ounces of gold and 4,354 ounces of silver, having a gross value of $124,331.

Queen

This property was located in the fall of 1896 and after spasmodic development work, was bonded by the Holmes Syndicate about 1900. This syndicate mined and shipped some 4,500 tons of ore yielding about 2,400 ounces of gold and 924 ounces of silver at the nearby Yellowstone mill. Late in 1902, believing the property to be exhausted of ore, they allowed their bond to lapse. It is probable that these operators thought the bottoming of the oxidized zone marked the termination of commercial ore as was the case in the nearby Yellowstone.

After the Holmes syndicate allowed its bond to lapse, William Waldie acquired the property. He soon had it producing steadily and continued to treat ore in the Yellowstone mill.

In 1906, Mr. Waldie sold the property to Queen Mines Incorporated, which company also acquired the adjoining Yellowstone property and mill. The mill was enlarged to 20 stamps and Wilfley tables were installed to make a shipping concentrate in addition to the regular malgam. This step was necessary as most of the ore coming from below the zone of oxidation was unsuitable for treatment by amalgamation alone.

Development was pushed ahead below creek level by means of a vertical shaft from No. 3 level west and production was maintained steadily until 1915, at which time labor trouble and increased costs together with adverse development results on No. 7 level caused cessation of operations. At that time, base metal mines were increasing wages and operation of gold properties was becoming increasingly difficult.

When higher wages were refused them, the miners went on strike, and the property was closed and only reopened for a short time in 1916 to draw broken ore from the stopes. Subsequently the mine was allowed to fill with water, and thus a very serious obstacle to any future development and mining operations was

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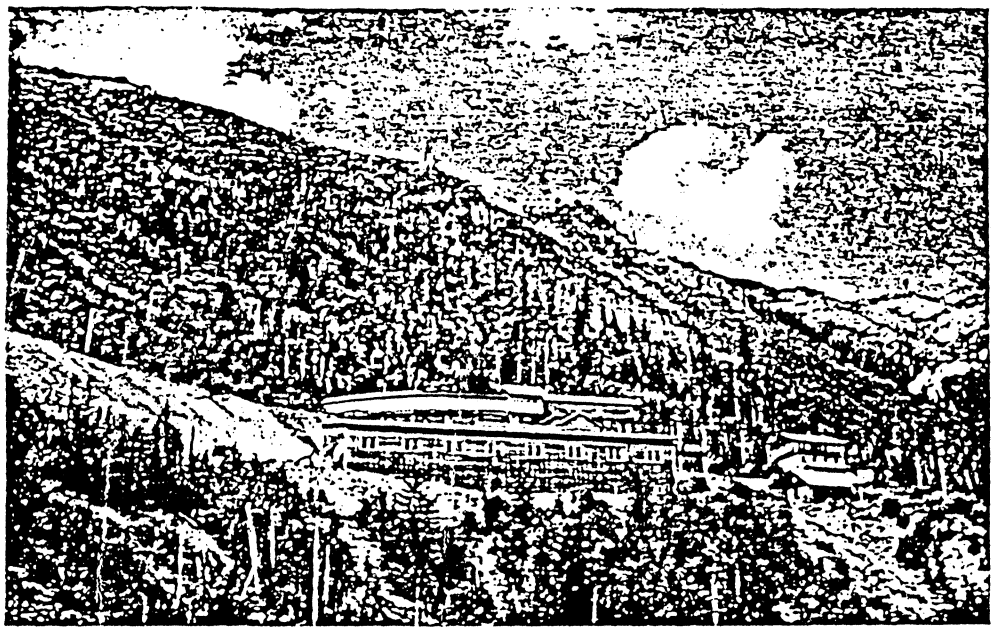
pr sented. During its 16-year period of operation, the records show the Queen mine to have produced 57,762 ounces of gold and 19,952 ounces of silver from 118,136 tons of ore milled. It is noted that during this time, no assays were regularly taken, mining control being almost entirely governed by mill and smelter returns. Mill tails were reported to be high and it is doubtful whether indicated returns of 0.488 ounces gold and 0.169 ounces of silver per ton represent more than a 65 per cent recovery.



Gold belt mill on south slope of Reno Mountain.

Subsequent to 1916, many attempts were made to revive the property, but with no great success until the present company took over operations in the fall of 1933. The most notable of these attempts was perhaps made in 1920 when the McCune interests of Salt Lake City optioned the Kootenay Belle, Queen and Vancouver properties and drove a 1,700-foot crosscut to intersect the Vancouver vein at depth. The crosscut was in an unfavorable belt and the work badly directed. The tunnel was stopped 800 feet short of its objective with disappointing results, as Yellowstone and Queen veins did not make ore on their extensions into the schists.

The problem of dewatering the workings on the old Queen vein was beyond the resources of the various parties interested in the property previous to 1933, the result being that work was confined to the upper levels of the Queen and the Vancouver and Alexandra veins on the property in another quartzite band to the east, from which small quantities of ore were mined and shipped from time to time.

Kootenay Belle

This property was located in 1898 and 1899 on surface showings of two small veins occurring close together in the eastern quartzite band above the Queen and Yellowstone veins. Surface ore was very high-grade, assaying several ounces to the ton, but although some ore shipments must have been made, no recorded production is listed for the property until 1905, at which time it was acquired by the Rogers Syndicate of Vancouver and a 4-stamp mill erected. Later this mill was enlarged to 10 stamps and a Wilfley table and Frue vanner installed. Production was on a very small scale until 1911, but in all 5,13 tons of ore yielded 5,022 ounces of gold and 2,328 ounces of silver having a gross value of $104,966 were mined and treated. All this ore was taken apparently from above the No. 1 crosscut-level and removed by aerial tram down to the mill. Although ore was far from bottomed, values decreased from 3 ounces of gold per ton at the start of operations to 0.5 ounce of gold per ton recovered at the end of the period, and this, coupled with the fact that another long crosscut was necessary to mine the ore below No. 1 level, discouraged the owners at the time from continuing operations and the property remained relatively idle until 1927.

In that year, however, F. M. Black and associates of Vancouver commenced shipments of crude high-grade ore from the upper levels. This policy was continued until February 28th, 1934, during which period 1,463 tons of crude ore, having a gross value of $55,461, were shipped. The present company was organized in 1933.

Motherlode

This group of claims was located in the early years of the century on the Sheep Creek slope of Reno mountain, principally on the surface showings of the Motherlode vein in the western quartzite belts. Ore occurred in two separate quartzite belts, later to be known as Nugget and Motherlode bands, the two being separated by an argillaceous band through which the vein was but a tight crack. The group was developed on a limited scale and small shipments were made from upper workings in the period 1906 to 1910, to the aggregate amount of 832 tons of sorted ore yielding 3,110 ounces of gold and 2,263 ounces of silver. During this time, the property was bonded by John McMartin and the title completed in 1910. Development work by 1910 had indicated enough ore to supply a mill of prescribed capacity for three years, and on the strength of this a company, known as the Motherlode Sheep Creek Mining Company, capitalized at $1,250,000, was organized.

After extensive tests of the ore in San Francisco, the Merrill Company installed a 100-ton cyanide plant (the first of its kind in British Columbia), the property being completed by the summer of 1912. The mine, meanwhile, was developed extensively from the lowest (500-foot level) from which a bucket tram was to transport ore 500 feet down the hillside to the mill on Sheep Creek.

Eventually, when the mill went into operation, the Motherlode became the largest producer in Sheep Creek, but for a period of three years only. By 1915 most of the ore above No. 5 level, which was about the lower limit of the oxidized zone, had been extracted. A winze had been sunk from No. 5 level into primary ore but drifting results were not very promising so operations were discontinued early in 1915.

During its 2½-year period of operation, the Motherlode mill treated 60,504 tons of ore from which was recovered 34,043 ounces of gold and 12,762 ounces of silver having a gross value of $706,180. This represented a recovery varying from 94 to 96 per cent of the values, and was an unusual performance at that time. The mill was nominally rated at 100 tons per day but often treated up to 125 tons per day. Although tonnage developed on the Motherlode vein obviously did not warrant the construction of such a large and expensive mill, from the point of view of economical operation the plant was all that could be desired, and was the forerunner of many more of its kind in British Columbia.

Nugget

This property, located on the south ridge of Reno mountain, directly above the Motherlode, was staked in the early 1900's. Of the seven veins on the property, the principal one

was the Nugget, which by 1910 was developed by four levels from both sides of the mountain. Crude ore was shipped in 1907; and, in 1908, Nugget Gold Mines, Limited, acquired the property and installed a 4-stamp steam-driven mill and concentrating equipment. The mine was worked continuously until 1911, during which time bullion was produced and concentrates shipped to Trail. 15,471 tons of ore, treated and shipped, yielded 16,089 ounces of gold and 3,101 ounces of silver having a gross value of $292,549 during this four-year period.

In 1911 control of the Nugget stock was acquired by R. S. Lennie and associates of Vancouver and Spokane. Thereafter due to labour difficulties, the mine was closed.

Nugget-Motherlode

In 1918, an amalgamation was effected with the Motherlode, and a new company, known as Nugget Gold Mines, Limited, organized, whose programme was to tap the Nugget vein in depth from the Motherlode workings. This project was commenced in March, 1919, and the objective 625 feet below No. 4 level on the Nugget vein was reached early in 1919 after 165 feet of crosscutting.

Development work began on the vein and some ore was blocked out. Milling was commenced but costs were so high at that time that its continuance was deemed inadvisable. The last recorded run until the properties were acquired by Reno Gold Mines in 1932 was from July to November, 1922. Apparently, the Nugget vein did not prove up as well on the lower elevation as on the higher horizons and much delay resulted when raising to the upper workings was undertaken in search of commercial ore. Lack of capital seems to have been the principal cause of cessation of further operations by this company.

Reno

This group of 16 claims was staked in 1912 by W. B. Poole, Mike O'Donnell and Thomas Kilpatrick. The group took in the summit of Reno mountain and extended over to the Hidden Creek slope. The Reno vein was the most important, and by far the richest showing, although the Donnybrook, Clarence and Lake veins towards Hidden Creek were also known.

Work was continuous on a small scale by the owners under the direction of Mr. Poole and by 1927, four levels had been driven on the Reno vein, all of which were in ore of very good grade. Towards the end of 1927, negotiations were under way for further financing, principally by English capital, and in 1928, camp construction and development were advanced. Work was also started on a 30-ton cyanide and flotation plant which first went into production in 1929.

Miscellaneous

Other smaller showings in the district which were worked in the early days, most of which did not prove of any great importance at that time, include Kootenay Ore Hill, Midnite and Vancouver, Alexandra, now owned by Sheep Creek Gold Mines and Bonanza, held by the same company under option; Navada, now split between Kootenay Belle and Gold Belt; Columbia and Clyde, which formed the nucleus of the present Gold Belt property; Golden Belle, latterly optioned to Kootenay Belle; and Golden Fawn and Bluestone, now owned by Reno. Of these, the Navada, Columbia and Clyde are the only ones that have proved of any great importance to date.

Eureka

An interesting sidelight on the district was provided in 1910, when interests representing Kaiser Wilhelm of Germany optioned the Davenport Group east of Reno and the Eureka in Motherlode quartzite, across the creek from the Motherlode mill. A few high-grade spots were found in the Eureka, whence some small shipments were made; and in 1912, the owners, William Kennedy and William McCarthy, were paid the full purchase price of $50,000. However, the outbreak of war soon caused cessation of all operations and the co-owners had their property returned. The Eureka has since proved of no importance as a mine.

Geological

General

Ore deposits in the Sheep Creek area lie within a series of beds consisting of fissle and schistose to massive argillaceous quartzites and pure quartzites overlain by lime-argillites, phyllites and limestones. All the above beds have been fixed as late Precambrian.*

Locally, the beds have been pushed into two sharply-folded anticlines and an intervening syncline. The axis of these structures strikes generally N. 8 to 12 degrees E., and their axial planes dip about 58 degrees E. with appreciably shallower dips at lower horizons. The eastern anticline is much the larger and appears to over-ride the smaller structure to the west to a certain extent. (Refer to Plates 1, 2, 3, 4 and 5.)

Although the different beds show a gradation, one into the other, and in most places the boundaries are optional, they have been locally divided into four series as follows: Motherlode, Nugget, Reno and Pend Oreille, in chronological order.

The Motherlode series consists of 200 to 300 feet of green weathering schistose argillite forming the core of the eastern anticline. This is overlain by 500 to 600 feet of generally massive white quartzite. The Motherlode series is encountered in the eastern anticline but has not been definitely placed to date in the western anticline, as granite, here, has assimilated most of this part of the structure. The Motherlode series has not proved of any great economic importance to date, the only known occurrence of ore of any significance being on the eastern extension of the Motherlode vein where ore was found in the upper quartzites of the series.

The Nugget series consists of 200 to 300 feet of argillite and argillaceous quartzite overlain by 800 to 900 feet of grey to white quartzite, for the most part, thin-bedded with occasional thin bands of argillaceous quartzite and limestone. Development of bedding planes and schistosity varies directly with the degree of folding of the anticlinal structures. The Nugget band is the host rock of most of the ore in Sheep Creek district. Fawn, Nugget, Motherlode, A and B, Black, Midnite and Vancouver, Alexandra and Bonanza veins are found in it in the western limb of the eastern anticline. In the crest of the anticline where the same band has a double thickness, the

*Walker, J. F., Geol. Survey of Canada, Memoir 172.

Geological-Key to Formations in Plates 1, 2, 3, 4 and 5

BA—Basal argillites of Motherlode series. Generally green weathering, schistose argillites.

MLQ—Motherlode quartzites. Massive, generally white, brittle quartzites.

NA—Nugget argillites of the Nugget series. Dark, generally schistose argillites.

NQ—Massive to thin bedded white and grey quartzites of the Nugget series. Generally brittle but contain occasional narrow bands of softer limy and argillaceous sediments.

RAQ—Generally schistose argillites with numerous interbeds of dark to white quartzites. Forms basal member of Reno series.

RQ—Dark to white quartzites. Brittle. Form core of the Reno series.

RA—Schistose to massive argillites, forming upper member of the Reno series.

PO—Pend Oreille series of sediments made up of limy argillites and dark, occasionally marbelized limestones.

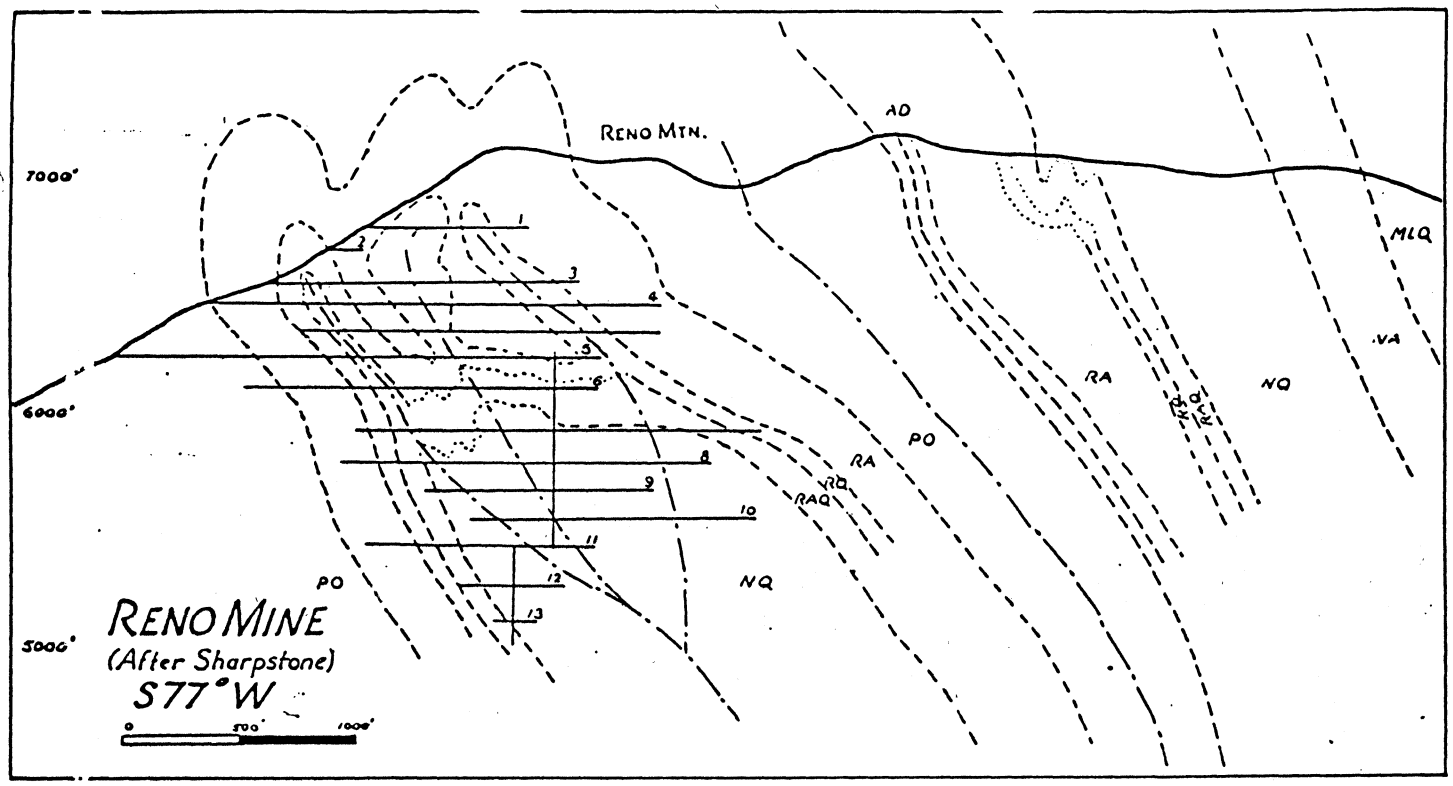


PLATE No. 1—*Reno Gold Mines, Ltd. Section across formations along strike of the Reno vein.*

lower part of the Reno, Coyote, Bluestone, 4500, 4300, 4100, 3900, 3700, 3040, 2590, 2360, 8200, 8000, 6600, Dixie, Yellowstone, Queen, 92, 85, 83, 81, 76, 75, 68 and 57 veins have ore-shoots or possibilities of ore shoots in it.

Directly overlying the Nugget series is the Reno series, which is from 400 to 500 feet in thickness and consists generally of schistose, argillites and argillaceous quartzites, and includes a band of 50 to 100 feet of hard, dark to white quartzite in its lower portion. This last mentioned hard layer has been subjected to intense folding and local thinning and thickening and places in the anticlinal crest with the resultant deformation of the softer surrounding beds. In some places, particularly the upper workings of the Gold Belt and the upper part of Reno vein, it is an important host for ore-shoots. The relatively impervious layers of the Reno formation probably acted as a seal for the rising mineralizing solutions and gases.

Immediately above the Reno series, the argillite grades into 300 to 400 feet of limy argillite, successively overlain by 200 to 300 feet of dark limestone, in places, marbelized. These beds are found on either wing of the two anticlines and extend down

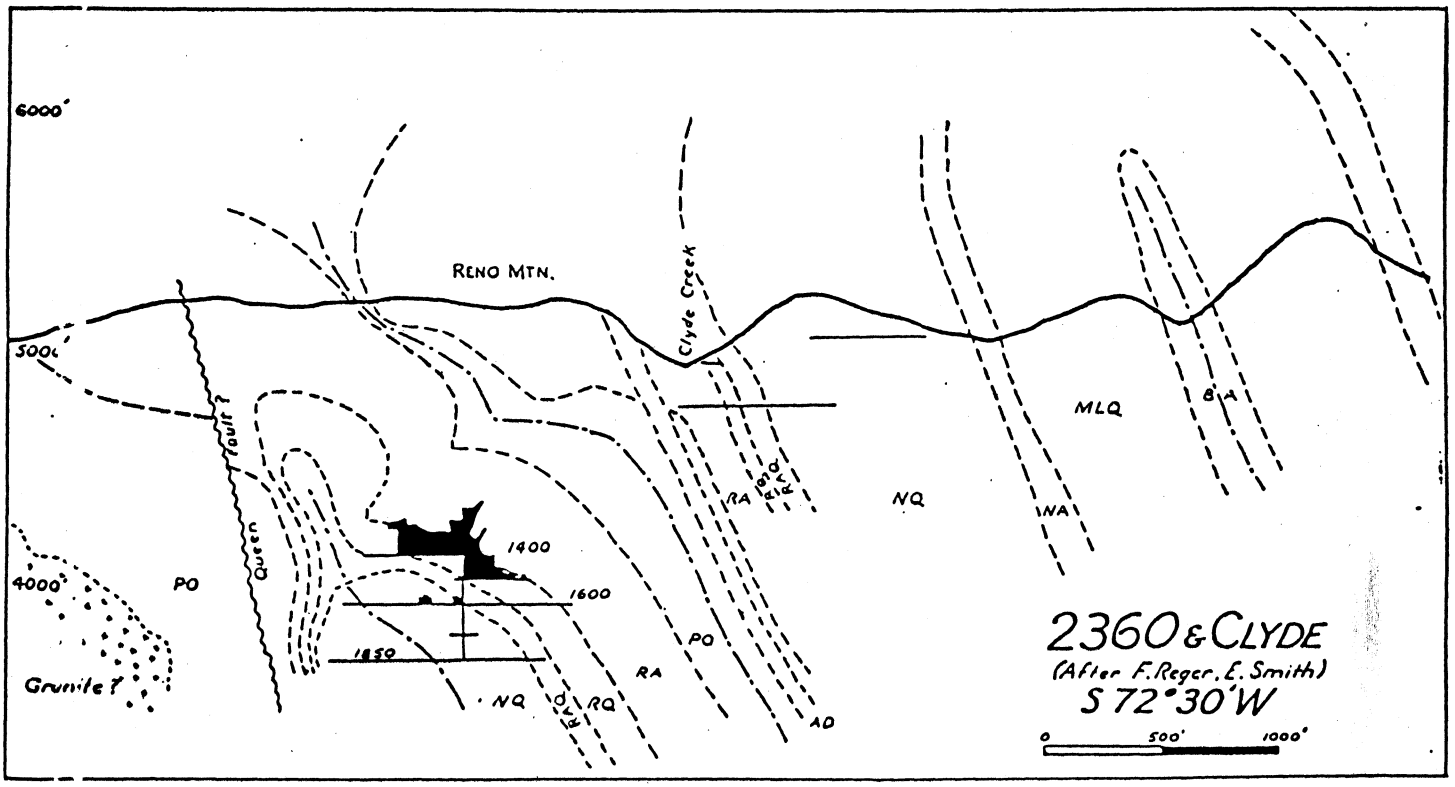


PLATE No. 2—*Gold Belt Mining Co., Ltd., and Golden Belle group (under option to Kootenay Belle Gold Mines, Ltd.). Section across formation along stroke of 2360-vein (Gold Blet) anod Clyde vein (Golden Belle)*

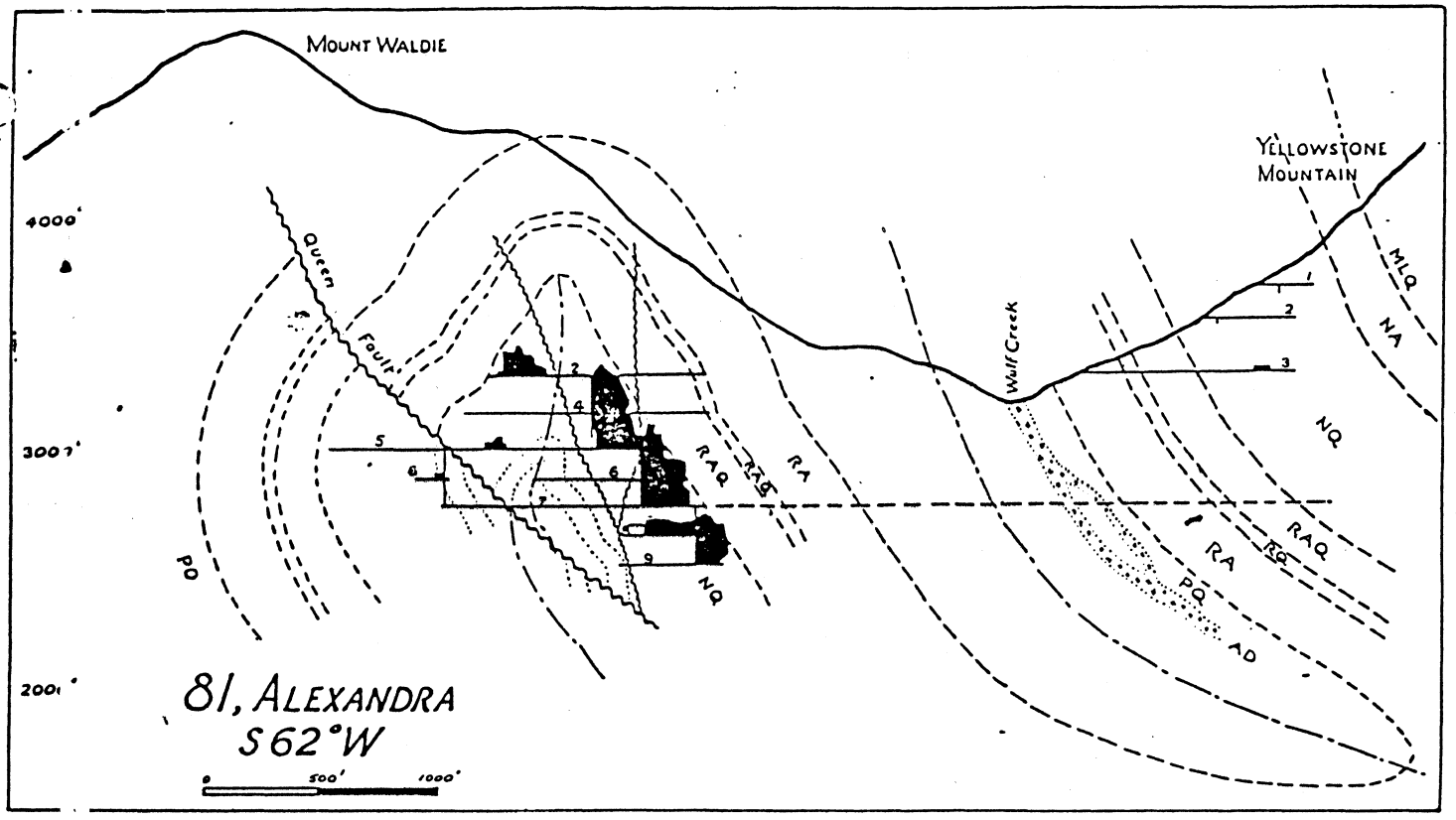


PLATE No. 5—*Sheep Creek Gold Mines, Ltd. Section across formation along strike of '81' and Alexandra veins.*

tered at 2200 feet elevation in the Queen shaft and a diamond-drill hole from this point in a westerly direction ran into a large body of it. Evidently, the lower parts of the anticlines and intervening synclines have been assimilated by the granite intrusive. Fairly extensive development work on the Queen vein (the lowest in the camp), suggests that temperature conditions did not permit of deposition of commercial ore deposits at a distance nearer than 600 feet from the granite.

As most of the veins in the camp now have been bottomed as far as commercial ore is concerned, the suggestion is that the contour of the underlying granite rises under the north end of the district, i.e., the section under Reno Mountain. Further evidence of this is shown by the fact that the crest of the Nugget quartzite in the western anticlinal structure plunges from an elevation of 6000 feet at the Reno vein near the top of Reno Mountain to an elevation of about 3900 feet at the 8000 vein, 11,000 feet to the south near Sheep Creek. This uplift is accompanied by a shift to the east of that part of the structure on Reno Mountain in relation to that part in Mount Valdie.

Accompanying this uplift or deformation which first shows at the 8000 vein in Gold Belt and becomes markedly more intense from the 2360 vein north (refer to Plate No. 2) is a marked deformation and thinning and thickening of some of the strata, especially in the crestal beds of the western anticlinal structure. This is also apparent in the upper levels of the Reno vein (see Plate No. 2). The Queen vein marks the low point on the structure (Plate No. 4) and the anticline rises at a very slight angle, progressing southward into Mount Valdie. (See Plate No. 5.)

Elevation of ore-horizons is then governed by two factors, namely the contour of the underlying granite and the amount of uplift of the anticlinal structures and would appear to be closely related to both.

Ore Deposits

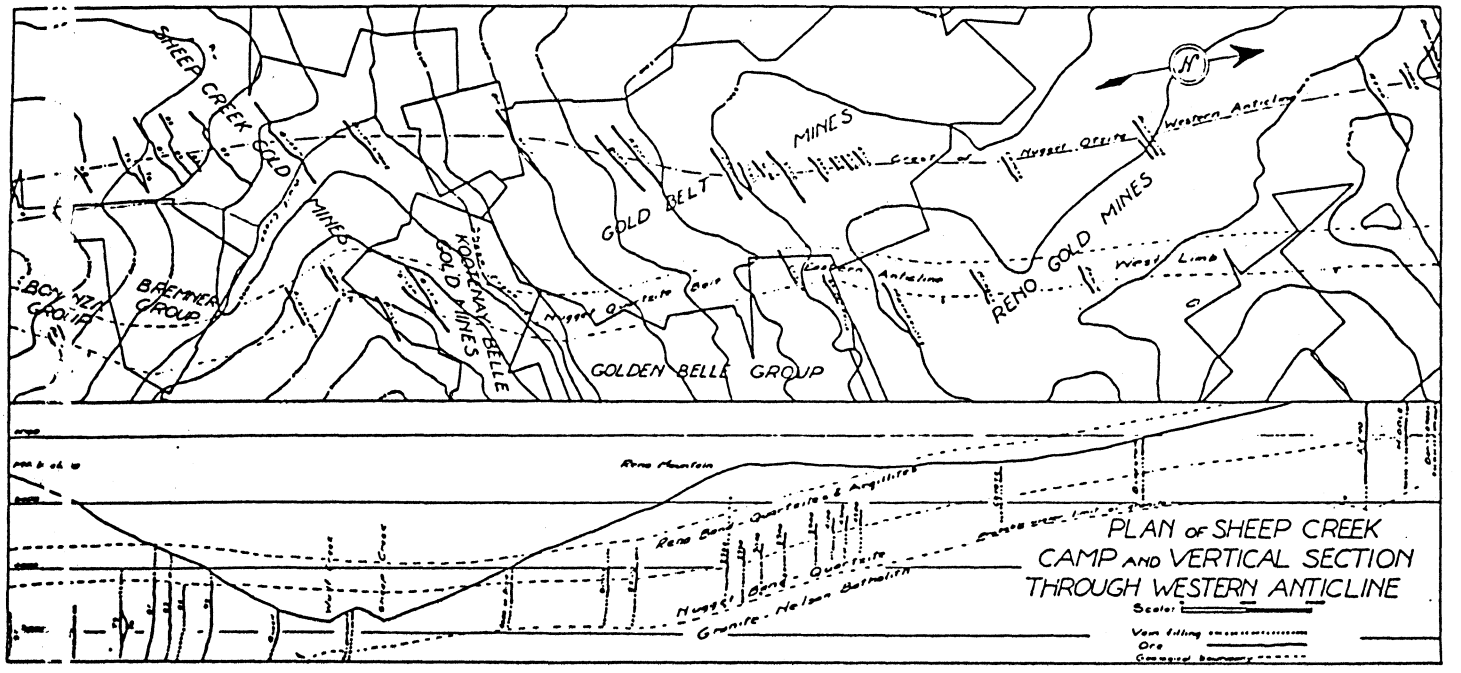
Shear fractures of a somewhat sinuous trend traverse the structures in directions varying from N. 35 degrees E. to N. 80 degrees E. In every case, the north wall of the fracture has been moved to the east and, in some cases, upward, in relation to the south wall. Apparent movement varies from 160 feet and 130 feet respectively on the Yellowstone and Queen veins to only a few feet on some of the veins. For most of the important veins in the camp, the apparent horizontal movement is from 12 to 50 feet but definite evidence as to amount of vertical movement is lacking.

Where the shears cross the brittle quartzite beds, a clean fracture results. Where they cross more resilient limy and argillaceous beds, the shearing force had a tendency to develop tensional fractures along the bedding planes and these combined with the shear fracture to form an echelon along the shear plane as in the Reno vein and the extension of the 92 vein into the argillites. However, no definite rule-of-thumb exists for this as veins of large movement such as the Yellowstone and the Queen show as clean straight shears on their extensions into the softer beds while veins of very small movement, such as the 57 and 68, show as echelons, even in the brittle white quartzites.

In many cases, two definite fractures seem to be allied with the same shear. Examples are the A and B veins in Kootenay Belle, the 75 and 76 veins and 85 and 83 veins in Sheep Creek. Generally, the fractures rejoin on vertical or lateral extensions.

All the veins along the eastern anticline have a pronounced dip to the south. Generally speaking, veins are nearly vertical in the upper and central portions of the western anticline and show a slight south dip on the wing which becomes more pronounced at depth.

Vein-filling, which consist of quartz and a variety of sulphides, is the result, partly of pressure of the mineral fluids themselves, but is more directly connected with openings caused by movement of the vein walls. The assumption is that such openings were maintained and successively reopened in the brittle hard quartzite beds, but in the more resilient limy and argillaceous beds, rock-pressure closed the openings, especially at lower horizons. Subsequently, reopenings for enrichment are explained in the same way. One prerequisite for



an ore-vein is hard quartzite on at least one wall. Where softer beds are found on both walls, the vein shows generally as a sheared crack and often echelons off into the bedding planes.

Dip of the bedding appears to have profound influence on angle of fracturing. Generally speaking, on the wings of either anticline where dip is more uniform and folding not particularly intense, long uniform veins or long tight cracks result while in the central and upper portions of the western anticline, where folding is more intense, vein filling is spotty and erratic.

Movement of the walls in relation to each other is still going on in some of the veins in the camp, especially the more important ones. Symptoms of this condition show by actual measurement, miniature rock blasts and banding of the sulphides. The 81 vein is an outstanding example. Such movement has, undoubtedly, in the past, resulted in enrichment of many of the veins.

Mineralization

Quartz and pyrite were the first minerals introduced into the veins and they were subsequently injected in smaller amounts during the whole period of mineralization. Pyrrhotite was next in order, but its occurrence is more erratic than pyrite. Sphalerite and fine galena were the last sulphide minerals introduced in any amount and they were closely followed by the gold-bearing solutions. Sphalerite at Sheep Creek acts as an indicator for gold, the assumption being that where openings were maintained for the sphalerite, they were generally maintained for the gold solutions. However, pyrite acts as the precipitant for gold in most cases and it is with that mineral that the gold in a free state is associated. Gold was found free in the upper levels of most of the veins in the early days. The values are sometimes quite general in the vein but more often occur as one or more high grade streaks running through the vein. Other minerals of much more erratic occurrence and whose period has not definitely been fixed include chalcopyrite, bornite and coarse galena. All three act as indicators of gold values where found. In parts of Kootenay Belle and in Gold Belt and Reno, a fine galena appears to be a better indicator for gold values than the sphalerite. This type of galena was closely associated with the sphalerite and gold.

In the lower levels of some of the veins, presumably on approaching the underlying granite batholith, veins are characterized by the presence of large amounts of various hydrous iron, lime and aluminum silicates which mark the bottom horizon of commercial gold values. Where these silicate minerals were not precipitated to such a great extent in the upper levels of the mines, they have been entirely absorbed by resilicification and give the quartz a bluish tinge.

Structural

Most of the ore-shoots are longer in their vertical than lateral dimensions, indicating their formation is more attributable to horizontal displacement. In some veins, such as the 81, there is a definite horizontal banding of the ore, indicating that vertical movement exerted a structural influence on the ore-body as well. Most of the larger ore-shoots occur where the fissure trends to the right off its usual course.

In the Sheep Creek property, most of the ore is confined to the white Nugget quartzite band with a possibility of ore occurring also in the outer hard quartzite band in the Reno layer, as yet largely untested. Proceeding north into Reno Mountain, the ore is found more and more in the upper crest of the Nugget and associated with the hard overlying Reno band. For example, ore in 81, 92 and Queen veins has been found almost entirely in the Nugget quartzite while in the northern part of the Gold Belt and in Reno vein, perhaps two-thirds of the values are found in or associated with the upper band of Reno quartzite. Along the eastern anticline, ore deposits are confined almost entirely to the Nugget quartzite with the same corresponding rise in ore horizons going into Reno Mountain as in the western anticlinal structure. Exceptions to the above are Eureka and part of Motherlode, where some ore was found in underlying quartzite (Motherlode) band.

Minor Intrusives

One large aplite porphyry dike, 40 to 80 feet wide, with a few similar associated dikes, are intruded along a plane parallel to and some distance east of the axial plane of the synclinal trough. The large dike outcrops through the whole district from north to south with a strike of N. 10 to 12 E., and is located about midway between the ore deposits of either syncline. In the past, much speculation has been aroused as to whether or not the ore deposits in the district are in any way connected with this dike. Recently, it and some other associated aplite dikes in depth have been found to assay small amounts in gold, always less than 0.10 ounce and generally less than 0.05 ounce, lending further credence to this view. However, the dike may be only the result of structural features caused by the intense folding in the district and may only,

for that reason, be fortuitously located between the white quartzite belts where the ore is found. It is not known whether this dike was intruded before, after or during the period of ore deposition.

Numerous lamprophyre dikes, representing the last phase of igneous intrusion, are found throughout the camp. They have followed the paths of least resistance, namely, the faults, the vein shears and the bedding planes. They have resulted in considerable dilution of the ore but have given no serious trouble in mining operations.

Faults

Aside from vein shearing, the only definitely known major fault in the district is the Queen fault, which slices across the western part of the western anticline at an angle and dip approximately that of the bedding. It passes out of the anticline at about 50 to 70 degrees east dip and shows a considerably shallower dip at lower elevations. It is definitely post mineral and the hanging wall (east side) has slipped down and southward about 230 feet and 130 feet respectively in relation to the footwall of the Queen vein. To the north, the Queen fault appears to line up with a fault running about N. 10 W. to N. 25 E. across Kootenay Belle Dixie claim and Gold Belt properties. Because of the eastward and upward shift of the anticlinal structure, the fault is largely confined to the overlying Pend Oreille sediments west of the structure and dips too steeply to affect the mine workings in Gold Belt. Farther north, the fault has not been definitely traced. The Queen fault appears to split up rather badly in the south end of Sheep Creek property.

A number of minor faults, generally paralleling the bedding and trending with the softer beds have resulted in minor displacements of the veins throughout the camp. Also, some small faults occur which were pre-mineral and have become obscured by silicification. There is evidence of post-mineral faulting along some of the veins, and this is still proceeding. In such places, the ore is softer and broken up and mining is made easier.

Recent History and Development

Reno

This, the oldest of the present operating companies of the district, put its 30-ton cyanide mill in operation on the Reno vein above Fawn Basin in September, 1929. Production was continuous until February, 1932, at which time the mill burnt down. During this period, tails ran high and recovery was only around 85 per cent.

After the destruction of the mill, the old Motherlode mill on Sheep Creek was acquired. During 1932, this mill was remodelled and a 12,600-foot tram line constructed down to it from No. 5 portal on the Reno vein. This mill went into production in November, 1932, and the Reno vein was mined more or less continuously until October, 1939, at which time it appeared exhausted of ore. The mine was developed on twelve levels with inside shafts from No. 5 level downward.

Development work cut the Donnybrook vein 1000 feet to the north and also cut another vein, not kown to outcrop, on the way. This was known as the Middle vein. Values were subcommercial in both.

During its 10-year production period, 263,437 tons of ore of 0.552 ounce grade and aggregate value of $4,738,537.75 were taken from the Reno vein to make it the premier producer in the district. Roughly two-thirds of the values came from the upper or Reno formation.

Meanwhile, when it appeared that the Reno vein was nearly exhausted of ore, a low-level tunnel known as the 4900, was driven to the Motherlode vein. This ore proved to be too low grade, but subsequent raising and sinking operations were moderately successful and the mill produced intermittently after the Reno vein was exhausted. From October, 1939, to November, 1940, the Motherlode vein yielded 39,197 tons of ore of 0.333 oz. grade and gross value of $500,388.21. In January, 1940, the Bluestone vein in Fawn Basin also went into production and to November, 1940, had produced 3,393 tons of ore of 0.249 ounce grade and gross value of $32,294.41. During the current year, operations have been curtailed at Reno but development work was continuous and the mill has recently gone into production on ore from the Nugget vein.

The present mill, as remodeled by the Reno Company is a modern cyanide plant capable of treating 150 tons per day; recovery is around 98 per cent.

Kootenay Belle

This company was incorporated in 1933 and an extensive mining and development programme was commenced on A and B veins. In 1934, a 50-ton mill was constructed with a Hardinge-Hadsel mill for fine grinding and flotation equipment. It produced continuously but proved too small and inadequate. In 1936 a modern 150-ton cyanide mill with conventional grinding equipment was installed and has been in continuous operation ever since, although tonnage has been curtailed somewhat during the past two years due to near exhaustion of ore from A vein, the principal producer.

The A and B vein system in Nugget quartzite of the eastern anticline has been developed on ten levels with a shaft down from 6 level. Production has been negligible below 7 level; and below 4 level, the ore was found to occur in more isolated lenses. Considerable development work was done on the Dixie vein, which is actually a western extension of the 6600-vein in the Gold Belt in the western anticline. However, only a 'stump' of an orebody was found, extending into Kootenay Belle ground in the crest of the Nugget quartzites, and this was so small that it little more than repaid the costs of development. (See Plate No. 3.)

Of recent interest is the Black vein, which is located 500 feet south of A-vein in the same Nugget quartzite band and which has been developed by crosscutting and drifting from 3-, 6- and 7-levels on A-vein. This vein has proved rather narrow but high-grade to date and, at present, constitutes the principal ore reserves of Kootenay Belle. Unfortunately it has a pronounced south dip and, below 7-level, it passes largely into Sheep Creek property.

Other veins on the property including the Queen and Yellowstone or possible extensions of them have not proved productive to date.

Golden Belle property, which includes two veins on Reno Mountain in the northern extension of Reno and Nugget beds in Kootenay Belle property, was recently optioned and developed but results proved disappointing and work has been discontinued.

Kootenay Belle is the smallest but most highly developed property in Sheep Creek and, next to Reno vein, its A vein has been the most consistent in the camp. Production from February, 1934, until February, 1941, has been $2,969,876 from 216,056 tons of ore whose average grade was around 0.37 ounce gold. 80 per cent of this production came from A vein with the remaining 20 per cent from B, Dixie and Black veins.

Sheep Creek

This company dates back to 1933 when the Midnite Gold Mining Syndicate and the Queen Mining and Milling Company were consolidated to form Sheep Creek Gold Mines Limited.

The old Queen workings were dewatered in February, 1934, and after some diamond drilling was done with negative results, actual development work was started on the Queen vein

in May, 1934. Ore was found after drifting for a short distance to the east and by crosscutting beneath the Queen fault to the west on 7-level. Results were such that a 150-ton cyanide plant was constructed and put into operation in May, 1935.

A new shaft was sunk from 7-level in the central part of the anticline and subsequently deepened 1050 feet below the collar, where tongues of granite were encountered and 8-, 9-, 10- and 12-levels were driven.

However, ore proved to bottom just below 8-level on the east wing of the anticline and at 7-level below the Queen fault to the west, and in consequence further development work took the form of crosscutting to the south along the gently dipping western anticline in the favorable Nugget quartzite beds to look for parallel veins, two of which were known to exist as tight breaks on the surface.

The 92-vein was encountered on the east wing of the anticline after 800 feet of crosscutting on both 5- and 7-levels, but did not make ore until drifting reached the central part of the anticlinal structure. Here, a high-grade ore-shoot was encountered which extended from 8-level up to 300 feet above 2-level, a vertical distance of over 900 feet. Other ore-shoots were later found on the 92-vein on both sides of the Queen fault, but it was this particular ore-shoot which assured the success of the Sheep Creek operation at that time.

Further crosscutting to the south revealed the 85-, 83-, 81-, 76-, 75-, 68- and 57-veins, of which the 81 has proved by far the most important. On the 81-vein, an ore-shoot on the east contact has extended from 70 feet above 2-level down to 9-level where it is still strong. Currently, another important ore-shoot is being developed on 5- and 6-levels on this vein near the west contact and below the Queen fault.

Ore shoots have been found on 85-, 83-, 76- and 75-veins but they are all largely undeveloped to date.

68- and 57-veins, which were tested still further south by drifting and diamond drilling, show narrow erratic but sometimes high-grade shoots. They show as weak breaks where encountered and do not extend up very far.

A crosscut north from the Queen vein on 7-level cut the Yellowstone vein 900 feet below surface workings where it showed as a wide, strong vein but was barren of values.

Work has been done from time to time on the Midnite, Bonanza and Alexandra veins in Nugget quartzite on the eastern anticline by surface tunnels but results have been disappointing.

Recently a 2060-foot crosscut from 7-level on 92-vein has been completed and encountered the Alexandra vein 500 feet below surface workings. It shows here as a narrow, flat-dipping break with erratic values only. The same crosscut is currently being driven north to test Midnite and Black veins in depth.

Sheep Creek has a production record of $5,503,343.19 gross value from 325,699 tons milled from the time its mill was put into operation in May, 1935, until the end of May, 1941, and is now the premier gold producer of the district, having passed Reno early in 1941.

Gold Belt

This, the youngest mine in the district, dates back to 1905-1, when a number of claims were staked and held under the name of the Gold Belt Mining Company. However, aside from a few tons of ore shipped from the Navada tunnel, no production is recorded for the early period.

The present company dates back to 1932, when the Lakes brothers realizing the significance of the quartzite belt, staked a number of claims on the south slope of Reno Mountain. In 1933, a consolidation of various claims was effected and the present Gold Belt Mining Company formed. Work on the upper (200 and 600 levels), largely in argillites, gave promise of better values in depth on several veins encountered.

In 1935, the North America Mines took over a controlling interest and instituted a development programme. The results ultimately justified the erection of a modern cyanide mill, which was constructed and put into operation in October, 1938. The plant has ever since been treating 150 to 170 tons of ore daily.

The 1850-level, started in 1935, hit the 8000- and 8200-veins in the Reno formation, where they showed as tight breaks only. This crosscut was advanced and intersected, in order, the 2360-, 2590- and 3040-veins in the Nugget quartzite anticline, all at points too low to make ore.

Meanwhile, drifting on the 8000- and 8200-veins to the west in the Nugget quartzite anticline showed substantial ore-shoots and the 2100-level was driven still lower to intersect them in the Nugget quartzite. A little low grade ore only was found here on the 8000-vein, but the important 6600-vein was encountered near the portal of the 2100-crosscut and subsequently developed and mined.

At the same time, raising on the 2360- and 2590-veins and subsequent further crosscutting to the north on 1400- and 1600-levels revealed ore on the 2360-, 2590- and 3040-veins in the crest of the Nugget quartzites. Important ore-shoots were also found in the overlying Reno quartzites on the 2360-vein.

Subsequently, crosscutting to the north on 1400- and 1600-levels revealed ore in the anticlinal crest on 3500-vein with increased values at the upper horizon. Accordingly, the 1400-level crosscut was advanced and encountered in succession, the 3900-, 4100-, 4300- and 4500-veins, all named according to footage from the 1850-portal.

A little ore was found on the 3900-vein, but because of the fact that the axis of the Nugget quartzite anticline rises steeply towards the north, in consequence of which the ore horizon also rises in this direction, it is believed that the last three veins were cut at points too low to intersect ore-shoots. The Western anticlinal structure at Gold Belt is nearly level from the 6600-vein to the 8200-vein, from which point it rises a bit to the 2350-vein and then rises much more steeply to the north towards the old Reno vein. Ore horizons have proved to rise with the structure so that the future of Gold Belt at present appears to lie in raising on the existing veins and gaining more and more elevation in crosscutting towards the north end of the property.

To date important shoots of ore have been found on the 8000-, 8200- and 2360-veins in the overlying Reno quartzite band, which appears very encouraging for future exploration on existing veins.

From October, 1928, to the end of March, 1941, the Gold Belt mill treated 145,129 tons, having a gross recovered value of $1,562,864.35.

Statistics

I. Value of Gross Production

Early Period

Mine	Period of Production	Value
Yellowstone	1900-1902	$ 115,000
Queen	1902-1916	1,204,726
Kootenay Belle	1905-1934*	160,427
Motherlode	1906-1915	771,600
Nugget	1907-1911	292,459
		$2,444,212

Recent Period

Mine	Period of Production	Value
Reno	Sept. 1, '29-Nov. 18, '40	$5,271,220
Kootenay Belle	Mar. 31, '34-Sept. 1, '41	3,207,246
Sheep Creek	May 31, '35-May 31, '41	5,503,343
Gold Belt	Oct. 31, '38-Mar. 31, '41	1,562,864
		$15,544,673
Grand total		$17,988,885

II. Gold Production by Individual Veins

Early Period

Veins	Tons	Oz. Gold	Grade
Yellowstone	17,167	5,912	0.345
Queen	118,136	57,762	0.488
"A" vein	3,000	6,300	2.100
"B" vein	1,000	800	0.800
Motherlode	61,136	37,153	0.607
Nugget	15,471	16,089	1.040
	215,910	124,016	0.574

Recent Period

Reno

Veins	Tons	Oz. Gold	Grade
Reno	263,437	145,417	0.552
Motherlode	39,137	13,033	0.333
Bluestone	3,393	849	0.249
	306,027	159,299	0.521

Kootenay Belle

Veins	Tons	Oz. Gold	Grade
"A" vein	191,523	75,619	0.395
"B" vein	30,781	7,709	0.251
Dixie	2,570	1,079	0.420
Blaine	10,521	4,270	0.405
	235,395	88,677	0.377

Sheep Creek

Veins	Tons	Oz. Gold	Grade
Queen	113,131	33,715	0.298
92	128,007	70,873	0.553
85	1,395	518	0.371
83	19,256	6,467	0.336
81	56,063	30,693	0.548
76	2,445	770	0.315
75	1,389	434	0.313
68	4,013	1,205	0.300
	325,699	144,675	0.444

Gold Belt

Veins	Tons	Oz. Gold	Grade
6600	26,998	10,430	0.386
8000	49,484	14,972	0.303
8200	35,723	9,228	0.258
2360	22,386	5,493	0.245
2590	157	60	0.380
3040	5,296	1,385	0.261
3500	5,085	1,861	0.366
	145,129	43,429	0.299
Total (recent period)	1,012,250	436,080	0.431

III. Costs*

Reno—For fiscal year ending June 30, 1938.

(a) Metallurgical Data

Ore milled-dry tons	50,068
Gold bullion. ounces	21,787
Assay, heads, ounces per ton	0.442
Assay, tails, ounces per ton	0.007
Recovered, ounces per ton	0.435 or 98.3%
Average daily tonnage	137.1
Value of heads per ton	$15.170

(b) Costs

	Per ton	Per ounce
Mining	$3.870	$8.893
Development	2.018	4.637
Aerial tramming	0.319	0.732
Milling	2.034	4.675
Marketing	0.096	0.221
Plant overhead	0.383	0.881
	$8.720	$20.039

Kootenay Belle—For fiscal year ending Feb. 28, 1939.

(a) Metallurgical Data

Ore milled, dry tons	48,984
Gold bullion, ounces	19,627
Assay, heads, ounces per ton	0.409
Assay, tails, ounces per ton	0.008
Recovered, ounces per ton	0.401 or 98.0%
Average daily tonnage	134.0
Value of heads per ton	$14.165

(b) Costs

	Per ton	Per ounce
Mining	$3.700	$9.250
Development	1.960	4.890
Ore transportation	0.380	0.940
Milling	1.330	3.330
Marketing	0.210	0.510
Mine administration	0.440	1.100
	$8.020	$20.020

Sheep Creek—For fiscal year ending May 31, 1941.

(a) Metallurgical Data

Ore milled, dry tons	55,504
Gold bullion, ounces	25,546
Assay, heads, ounces per ton	0.476
Assay, tails, ounces per ton	0.012
Recovered, ounces per ton	0.464 or 97.48%
Value of heads per ton	$17.776

(b) Costs

	Per ton	Per ounce
Mining	$2.935	$6.325
Development	1.708	3.681
Ore delivery to mill	0.082	0.177
Milling	1.605	3.459
Refining	0.029	0.062
Marketing	0.225	0.485
	$6.584	$14.189

Gold Belt—For fiscal year ending March 31, 1941.

(a) Metallurgical Data

Ore milled, dry tons	62,037
Gold bullion. ounces	16,686
Assay, heads, ounces per ton	0.279
Assay, tails, ounces per ton	0.009
Recovered, ounces per ton	0.270 or 96.21%
Value of heads per ton	$10.397

(b) Costs

	Per ton	Per ounce
Mining	$3.162	$11.326
Development	1.882	6.749
Milling	1.217	4.358
Ore delivery to mill	0.111	0.398
Refining	0.016	0.057
Marketing	0.134	0.480
	$6.522	$23.368

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