GEOLOGY AND HISTORY OF THE MARYSVILLE MINING DISTRICT AND THE DRUMLUMMON MINE, LEWIS AND CLARK COUNTY, MONTANA

by
Giles E. Walker

1992
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**Front Cover**  
Marysville and Drumlummon mine (left), *circa 1887*  
by  
Elaine Locati
Preface

The Marysville mining district is located at Marysville, Montana about 25 miles northwest of Helena, the State Capital. Historically, the district produced about 1.1 million ounces of gold from fissure veins in and adjacent to the quartz diorite Marysville stock (79 Ma). Host rocks in the district are the Empire Formation overlain by the Helena Formation of Precambrian age.

Placer mining commenced in the district in the 1860s and was followed by lode mining in the 1870s. The district flourished for the next two decades, but began to decline after the turn of the century, although some mining continued until after World War I. The district remained relatively quiet, aside from minor activity during World War II. In the 1960s and 1970s, a molybdenum prospect and high crustal heat flow was detected in the western portion. This period was subsequently followed by a minor revival of ongoing gold interest in the 1980s.

Early investigators tended to relate veining and mineralization to the emplacement of the Marysville stock. As a corollary, most early reporters also concluded that, with the exception of the Drumlimmon mine, all properties were shallow and relatively unimportant. In contrast, however, geologic studies during the last two decades have disclosed a series of shallow emplaced Tertiary intrusive centers (37-49 Ma) controlled beneath a NW-trending anticline west of the stock. Mineralization has been dated at 37 Ma, which has been intermittently active from 82 to 45 Ma. Faulting appears to have been both longitudinal and transverse relative to anticlinal formation. The latter resulted in a district-scale pattern of fissuring which focused on the eastern contact of the stock (Drumlimmon mine site). Structurally, the district lies at the southeast end of the Lewis and Clark line.

Recent exploration has revealed that economic mineralization may persist in depth along principal fractures. The potential vertical range for mineral occurrence under favorable structural circumstances appears to be about 2,000 feet. A district-wide mineral zoning seems indicated by the relative distribution of base and precious metals. The sources of mineralization are speculated to be the concealed Tertiary centers.

The historic Drumlimmon mine produced almost 0.6 million ounces of gold and 5.0 million ounces of silver in the late 19th century. Paralleling this achievement, however, was its questionable distinction of hosting 20 years of intense “apex rights” litigation, extending on several occasions to the U.S. Supreme Court. The saga of the mine, including technical achievements, the unfortunate positioning of claims versus geology, resulting complex, convoluted litigation and ultimate abandonment, provide a fascinating insight into the early mining history of Montana.

The author would like to thank David Blackwell of Southern Methodist University and Marvin Ratcliff, consulting geologist from Helena, for their critical reviews of the manuscript. Their comments and suggestions are gratefully acknowledged.

Giles E. Walker
Consulting Geologist

September 14, 1992
Helena
Figure 1—Location map of the Marysville gold district.
Marysville mining district

Introduction

The historic Marysville mining district is located about 25 miles northwest of Helena, Montana (Figure 1). The district comprises an area of approximately 12 square miles, partly astride the Continental Divide. Mount Belmont (7,331 ft.), a prominent peak, is centrally located within the district just north of the divide.

Gold provided the impetus for the district's development. Activity commenced in the mid-1870s, and continued until about 1910, with some properties being mined through World War I. During its peak, the district hosted at least eight significant operations, plus a number of lesser properties. Total district production from these early years appears to have exceeded $53,000,000 from gold and silver. Assuming that gold accounted for at least 75 percent of the value, this equates to about 1.1 million ounces.

Mining was revived briefly before and during World War II, but by 1960 it was at a standstill. A molybdenum prospect and a zone of high heat flow were discovered in the western part of the district in the late 1960s. This led to fairly extensive drilling programs plus a National Science Foundation-funded geothermal project. Neither of the above were economically successful. Rising gold prices in the early 1980s, however, led to renewed interest in this commodity and reopening of the historic Bald Mountain mine.

Early geologic information on the district includes the work of Barrell (1907) and Pardee and Schrader (1933). Geologic mapping of the district was conducted during the molybdenum exploration period (Marvin Ratcliff, Written Communication, 1972), as well as geothermal studies conducted by Southern Methodist University (David Blackwell, Written Communication, 1974). Recent underground exploration at the Bald Mountain mine has further added knowledge of the district.

The result of this work has provided a much clearer understanding of Marysville area geology. This report will review district geology, incorporate newly developed information, and relate current thoughts on structural development, ore control and mineral distribution. Short descriptions of the historic mines are also provided.

History

The Marysville mining district recorded its first lode claim activity in the mid-1870s. The Penobscot mine was located by Nate Vestal in about 1873 making it one of the earliest. Thomas Cruse filed the Bald Mountain claim in August 1875, and followed with the Drummond discovery in 1876. Numerous other discoveries were also being made, and by the early 1880s the district was flourishing.

The town of Marysville (now a "ghost") was established in 1870 and quickly developed along with the mines. It was named for Mary Ralston, an early-day resident of the area. During its prime, it housed 4,000 residents and 60 businesses, was served by two railroads and had two newspapers (Herrin and others, 1987). The original townsite was located immediately below the Belmont mine, but migrated down the gulch to its present site with the coming of the Northern Pacific Railroad in 1883 (L.S. Ropes, Written Communication, 1936).

Gold production from properties in the district was reported by L.S. Ropes (Written Communication, 1936).

<table>
<thead>
<tr>
<th>Mine Name</th>
<th>Production</th>
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<tbody>
<tr>
<td>Drummond mine (Montana Company)</td>
<td>$28,000,000</td>
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<tr>
<td>Drummond mine (St. Louis Company)</td>
<td>1,075,000</td>
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<tr>
<td>Bald Butte mine</td>
<td>3,500,000</td>
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Gloster mine 3,500,000
Bald Mountain mine 3,500,000
Shannon mine 2,700,000
Belmont mine 2,500,000
Empire mine 2,250,000
Penobscot mine 1,250,000
Bell Boy mine 650,000
Blue Bird - Hickey mine 600,000
Mt. Pleasant mine 50,000
Honeycomb mine 25,000
Emma Miller/Neenan/Rose Densmore/Kountz mines 125,000
Total lode mines $49,955,000
Silver Creek placers 2,500,000
Plegan Gulch placers 200,000
Gloster tailing 200,000
Total placer mines 2,950,000
Total district (at $35.67/oz.) $52,905,000

There were also a number of other ownerships in the district of which no records were found: the Towsley Gulch properties, which included the Shakopee, Towsley, Earthquake, Nile and Jerusha mines.

Early mining development in the district suffered from problems, which to some degree typifies most early-day camps, as L.S. Ropes (Written Communication, 1936) reports.

... criteria such as carefully blocked ore reserves were not given much thought. A gold “discovery” was followed by prospecting of the outcrop and equipment ordered. This would include a small stamp mill, with or without vanners, iron crusher and steam engine. These items would come up the Missouri River to Fort Benton in the Spring and then be hauled overland to Marysville. If sinking had to be done, a simple horse whim was operated until a steam driven hoist could be acquired. No surplus profits were accumulated or budgeted to cover new exploration or meet emergencies. Profits, instead, were all paid out in dividends. In some instances a mine might shut down until the owners or subsequent group could locate the next lead.

Mining activity peaked in the late 1880s and early 1890s; only the more organized groups maintained relatively continuous production. These included the Drumummon and Bald Mountain mines. The other district properties were all characterized by intermittent operations. The Drumummon essentially ceased production in 1904 due to protracted litigation between its owner, the Montana Company (English) and the adjacent St. Louis Mining and Milling Company. The Bald Mountain property continued to be reasonably active up to the time that its owner, Thomas Cruse, died in 1914. Conversely, the Shannon mine, although it had been opened, was not brought into full production until acquired by the Barnes-King Development Company in 1916; it operated until 1923. The Barnes-King Development Company was also operating the Gloster mill at the same time and transported the Shannon ore to the mill by aerial tram for treatment.

The district entered a prolonged period of relative quiescence after World War I. Mining activity encompassed only minor operations until the mid-1930s, when efforts were made to reopen the Bald Mountain mine by the Cruse Gold Company. They were succeeded by Silver Crescent, Inc. of Spokane, Washington. This effort appears to have been under financed and did not succeed. A parallel effort by the Montana Rainbow Company (1941-1950) at the Drumummon, however, was successful. The mine was reopened under the direction of William Wade. New ore was discovered and production was maintained through World War II until the mill burned in 1950.

The next major period of interest, centered around molybdenum exploration, began in the Bald Butte area in the mid-1960s. This work was undertaken by AMAX Exploration, Inc. and expanded to include a second project along Empire Creek below the Empire mine. In the early 1970s, diamond drilling in the latter area disclosed anomalously high heat flows. This revelation spawned an intense heat flow study program. Eventually, a deep
geothermal hole (6,809 ft) was drilled by the U.S. Government under the direction of Battelle Laboratory as prime contractor. Southern Methodist University provided the geological guidance for this effort. Unfortunately, the molybdenum and geothermal programs were not economically successful (David Blackwell, Written Communication, 1974).

Gold prices rose in the early 1980s. AMAX Exploration, Inc. commenced work at the Bald Mountain mine in 1982, and was followed by its partner, Gulf Titanium Ltd. of Vancouver, B.C. in 1986. During this period, the mine was reopened, evaluated, new exploration and development was carried out and production was achieved. A parallel effort by the Goldsil Mining and Milling Company to reopen the Drumilummon mine, however, did not achieve its goal.

Geology

Metasedimentary rocks

Units of the Precambrian Belt Supergroup comprise the metasedimentary host rocks in the Marysville mining district (Sheet 1, back pocket).

Empire Formation

This unit is the oldest formation exposed in the district. It occurs in a broad zone north of the Marysville stock, as well as in an elongate belt between Empire Creek on the northwest and Bald Butte to the southeast. The formation is composed of compact, locally calcareous, light to dark, greenish-gray shale (Ross, 1963). Near the Marysville stock, the shale has been converted to a fine-grained, light to dark green, gray or black hornfels that is banded green or purple and includes rare, dark-colored cordierite-bearing horizons (David Blackwell, Written Communication, 1974).

Helena Formation

The Helena Formation consists of limestone that occupies a broad zone around the eastern, southern and western portions of the stock, as described by David Blackwell (Written Communication, 1974),

It consists of two lithologies, commonly interbedded on the outcrop scale. Most common is impure siliceous limestone which occurs as edgewise conglomerate or "molar tooth" structure (Knopf, 1950). Grey limestone weathers readily while the buff quartz-calcite-mica matrix stands out on the weathered surface. The second lithology is white, brown weathering siliceous dolomite . . .

Between the Helena and Empire formations is a transitional zone about 40 meters (132 ft.) thick. The contact is drawn near the middle of this zone where calcite-rich rocks become common. The transitional rocks are most commonly banded hornfels containing white and light to dark green bands one half to one centimeter in width. At low grades these rocks locally have the appearance of shale, but their metamorphic character is shown by the presence of talc.

Mount Shields Formation

The Mount Shields Formation consists of interbedded buff or red to maroon shales, siliceous shales and mudstones that occur in the southwest and southern parts of the map area. The unit is in a fault relationship with the older Helena and Empire formations.

Intrusive rocks

A varied suite of igneous rocks exists in the district. These range from pre-Laramide micdiorite sills and dikes to quartz diorite, intermediate porphyry dikes or quartz-feldspar porphyry plutons.
Microdiorite

The microdiorite (Precambrian ?) occurs as thin sills or dikes in the Empire and Helena formations. The intrusives are dense, dark brown or black in color, thin, usually three feet or less, and are randomly present throughout the district. Where present, they may appear as swarms characterized by multiple, parallel bands apparently emplaced along bedding.

Quartz diorite

This intrusive (79 Ma) forms the Marysville stock (Baadsgard and others, 1961). It is an irregular, elongate body which extends two miles northwest from town (Sheet 1, back pocket). The main body is marked by a dike extension trending southwest for about 4,500 feet. The stock is widest, about 1.5 miles, to the southeast near Marysville and narrows to the northwest.

Knopf (1913) described the quartz diorite as

... a medium-grained, granitic rock composed essentially of andesine, quartz, orthoclase, biotite and hornblende.

David Blackwell (Written Communication, 1974) termed the stock, granodiorite. Barrell (1907) suggested that it was emplaced as a crosscutting body which stope its way into the sedimentary cover, causing some arching of the sediments.

Magnetic modelling during the course of heat flow investigations (David Blackwell, Written Communication, 1974) indicated the stock to be steep sided on the northeast and southeast sides. To the southwest and northwest, the upper contact dips shallowly westward before turning vertical (Sheet 2, back pocket).

Intermediate porphyries

There are three types of porphyries of intermediate composition included in the district — the Belmont porphyry, Drumlummon porphyry and a porphyritic hornblende diorite. The Belmont diorite porphyry was described by Knopf (1913) as

... being of conspicuously porphyritic texture, containing prominent crystals of andesine feldspar, together with prisms of hornblende and flakes of biotite in lesser amounts, in a dark gray groundmass.

The Belmont porphyry forms persistent NW-striking dikes exposed on slopes southwest of Mount Belmont; it also forms a prominent NW-striking dike extending from Bald Butte to the vicinity of Towsley Gulch.

The Drumlummon porphyry has been noted primarily in the Drumlummon mine and was described by Knopf (1913) as

... a grayish porphyry carrying small scattered phenocrysts of plagioclase feldspar in an aphanitic groundmass.

The Belmont and Drumlummon porphyries are known to occur in the quartz diorite Marysville stock. Knopf (1913) believed the Belmont porphyry to have been injected soon after the main intrusion of quartz diorite. The genetic relation of the Drumlummon porphyry is uncertain.

The third intermediate porphyritic hornblende diorite was described by Marvin Ratcliff (Written Communication, 1972) as

... a fine grained gray to greenish gray hornblende diorite dikes with up to 15 percent narrow euhedral hornblende up to 1 centimeter (<0.5 in.) in length.
Two hornblende diorite dikes have been recognized, one in the Bald Butte area where it cuts an older Belmont porphyry dike and a second in Towsley Gulch. At the latter site, the hornblende diorite occurs adjacent to a Belmont porphyry dike paralleling it along the hanging wall. The hornblende diorite was dated at 50 Ma (Marvin Ratcliff, Written Communication, 1972).

Quartz/quartz-feldspar porphyry plutons

Diamond drilling at Bald Butte (during molybdenum exploration) revealed at shallow depth (< 300 ft), a complex series of rhyolite quartz porphyry intrusions capped by a zone of silica flooding (Sheet 2, back pocket). The main Bald Butte quartz porphyry, dated at 49 Ma, was later intruded by a series of quartz porphyry dikes and sills ranging from 37 to 40 Ma (Blackwell and Morgen, 1975). With slight variations, these rocks are characterized by quartz phenocrysts in a light-colored, fine-grained to aphanitic groundmass.

Similar rocks have been encountered about one mile west of the Empire mine along Empire Creek. At this site a quartz-feldspar (granite) porphyry (40 Ma) overlain by massive silica was discovered. The intrusion occurs at shallow depth with the quartz flooding extending to the surface.

Extrusive rocks

Tertiary rhyolites occur in limited exposures in the southwest part of the Marysville mining district south of Bald Butte. The rhyolite includes angular, smoky quartz phenocrysts in a light-gray, aphanitic groundmass. The rock has been dated at 37 Ma (Marvin Ratcliff, Written Communication, 1972).

Contact metamorphism

Throughout the district, the Empire and Helena formations have been affected to some degree by thermal metamorphism. According to David Blackwell (Written Communication, 1974)

The areas of increased metamorphic grade show a clear spatial relationship to the outcrop of the Marysville stock and to the localities where quartz porphries were encountered in drill holes at Bald Butte and Empire Creek.

Metamorphic zones were delineated (David Blackwell, Written Communication, 1974) based upon the presence of carbonates and silicates (dolomite, talc, tremolite-actinolite and diopside). A prominent diopside halo surrounds the Marysville stock and extends outwards to the southwest for about 700 meters (2,300 ft.). This zone extends southwest as it curves around the dike-like extension of the stock. Similar diopside zones overlie the concealed Bald Butte and Empire Creek quartz porphries. The Empire Creek diopside zone extends southeast to include Towsley Gulch and the headwaters of Lost Horse Creek.

A tremolite zone occurs outside the diopside zone. A minor talc zone occurs near the Empire mine and a dolomite zone occurs in the southern portion about one mile east of Bald Butte.

According to David Blackwell (Written Communication, 1974)

... temperatures ranged from 400 degrees C away from the metamorphic highs to 500 degrees C at the center of the Bald Butte high and 525 degrees C in the Empire Creek high. Highest grade at the Marysville stock contact indicate somewhat higher temperatures. Geothermal gradients over diopside-bearing rocks were in excess of 125 degrees C/km during metamorphism.

The regional heat flow anomaly encompasses the Bald Butte-Empire Creek anticline, including the diopside alteration zones at both terminations of the anticline (Sheet 1, back pocket).
Structure

Regional setting

The Marysville district is near the southeast end of the Lewis and Clark line, a prominent zone of right-lateral, strike-slip faulting. The zone extends from Coeur d'Alene, Idaho to Helena, Montana, and is a major fault zone that has been intermittently active since Middle Proterozoic time, and had a significant period of activity between 82 and 45 Ma (Wallace and others, 1988).

Two elements of this trend are located in the Marysville area—one designated as the Bald Butte splay, and the other is shown as lying to the northeast, trending southeast to the north end of the Helena valley. The Bald Butte splay, as identified, probably correlates with the major northwest faults mapped southwest of Bald Butte (Marvin Ratcliff, Written Communication, 1972; David Blackwell, Written Communication, 1974).

The district also occurs within the Intermountain seismic belt. Earthquake surveys conducted near Helena in 1973 indicate a possible relationship between the local seismicity and the nearby Marysville high heat-flow area (Friedline and others, 1976).

Folding

The metasediments around the Marysville stock dip away from the stock and appear to have been slightly domed by the intrusion. Southwest of the stock, the attitude of the metasediments is modified by a doubly-plunging anticline (Marvin Ratcliff, Written Communication, 1972; David Blackwell, Written Communication, 1974) that extends from Empire Creek southeast to Bald Butte. Structurally, its origin possibly reflects a combination of doming from the underlying Tertiary intrusions coupled with tectonism (compression). Lithologically, the anticline is characterized by the older Empire Formation in outcrop, as the younger Helena Formation was eroded (except where protected by fault inliers); the configuration of the anticline appears symmetrical.

Faulting

There have been three principal stages of faulting of direct consequence to mineralization. An early stage, northwest pattern developed concurrent with folding. This system is characterized by relatively wide-spaced fractures dipping 65-90 degrees southwest. They occur primarily along the axis of the anticline, or in the metasediments between it and the stock. Their position is marked by later Belmont dike intrusions.

A middle stage of faulting followed intrusion of the Belmont and Drumlummon porphyry dikes. This stage, the most important to mineralization, resulted in three distinct patterns. The dominant one is of district scale, and portrays a somewhat radial system with strikes ranging from near east-west in the southern part of the district to northwest in the northern part. This pattern tends to focus on the southeastern contact of the Marysville stock, possibly due to the change in rock types. These faults are persistent with apparent strike lengths of 12,000 to 15,000 feet. Their attitude, with some exceptions, is steeply south to vertical. These faults persist through the metasediment cover and into the stock. Displacements are commonly normal and primarily dip slip.

Two less dominant patterns also formed during middle stage faulting. One system strikes N60°-70°W dipping steeply southwest (60°-80°), the other strikes N40°-50°W and dips 40°-60° northeast. These systems are not persistent and appear to have formed contemporaneously with the principal middle stage faults. Their intersections with the latter show little or no offsetting.

Late stage faulting took place after mineralization. These faults strike about N25°-40°W and dip steeply to vertical. Displacements are generally dip slip. The faults control the Empire Creek graben and several other
smaller down-dropped blocks. The Transcontinental fault at the Drumlummon mine is questionably assigned to this stage.

The bounding faults along the Empire Creek graben offset veins of the Empire mine, as well as the east-west veins in the Mount Pleasant and Blue Bird-Hickey-Shannon areas. The northeast bounding fault, where drilled just east of the Empire mine, is an intensely brecciated and crushed zone measuring about 70 to 80 feet thick.

Economic geology

Mineralogy

The Marysville mineral deposits are epigenetic and epithermal. The gangue mineralogy of veins throughout the district, aside from Towsley Gulch, is characteristically composed of varying amounts of quartz, carbonate and adularia. Towsley Gulch veins (in contrast) are composed of a matrix of brecciated country rock with only minimal amounts of quartz. No detailed petrologic examination of gangue mineral proportions has been done for the district. However, four thin sections of drill core from the Bald Mountain vein (Belmont) averaged 60 percent quartz, 35 percent calcite and 5 percent adularia (S. Koehler, Written Communication, 1988). Adularia from the Penobscot vein was dated at 37 Ma (Marvin Ratcliff, Written Communication, 1972).

Marysville ores are typified by a lamellar texture caused by silica replacement of early calcite lamellae (Knopf, 1913). Crystallization is also common. As a result, the ores are vuggy or angular in appearance. Partly assimilated fragments of host rock are present within the veins.

Gold, for the most part, occurs free. However, earlier reports do indicate that some part may have been associated with pyrite at the Drumlummon and possibly at the Glover; silver mineralogy varies to a small degree. At the Belmont, silver has been identified as acanthite (S.W. Koehler, Personal Communication, 1988) and associated with gold. Drumlummon ores, in contrast, contained tetrahedrite (freibergite; Knopf, 1913) and pearsite (polybasite group). The latter was named by S.L. Penfield of Yale University from a specimen collected from the mine by Richard Pearce in 1895 (Goodale, 1915).

Historically, visible gold was common in Marysville ores. Recent work at the Belmont mine, however, has not disclosed any visible gold, although it can be detected easily by crushing and panning. Belmont gold is freely disseminated in both quartz and calcite, and commonly ranges from 20 to 40 microns in size. Marysville ores have generally averaged 0.5 to 1.0 ounce of gold per ton, but may range to several ounces. Silver to gold ratios are also variable, but probably range between Bald Mountain and Drumlummon values. The Belmont ores average about 3:1; similar averages are reported for the North Star vein, which is considered to be the eastern continuation of the Belmont vein. The Drumlummon vein ore, in contrast, was reported to average about 10:1 (Goodale, 1915).

Sulfides increase at depth. In deeper drilling at the Belmont, pyrite occurs as disseminations and along thin veinlets, with minor amounts of chalcopyrite. A similar increase was also noted in other Marysville properties with depth. Trace to moderate amounts of galena and sphalerite occur at the Drumlummon and Bald Butte. The Towsley gulch properties contain high-grade gold (Bell Boy mine), but ores contain significant amounts of cerussite, calamine, azurite and malachite. The Empire mine also reportedly encountered high-grade galena.

A somewhat different aspect of Marysville geology is represented by the concealed Tertiary centers at Bald Butte and Empire Creek. The veins associated with these centers, in addition to the normal epithermal suite, are characterized by relatively widespread fluorite and varying amounts of molybdenite. The Towsley Gulch ores also contain fluorite.
Paragenetically, Pardee and Schrader (1933) reported the following sequence at the Bell Boy mine:

*Early*: chalcopyrite, fluorite, galena (sphalerite), chlorite, biotite

*Late*: quartz, calcite (leached)

The positioning of gold and silver are not specifically mentioned in this sequence, but presumably these came late with the quartz and/or carbonate.

The paragenetic sequence at the Belmont mine was:

Calcite, quartz, calcite

Gold and silver appear to have accompanied all stages as they are freely disseminated in both quartz and calcite.

**Veins**

The principal fissure veins formed in the *middle stage*, east-west to northwest-striking radial faults. The Drumlummon vein resulted from convergence (or intersection) of several of the southernmost faults along the relatively incompetent southeast contact of the stock. The secondary and contemporaneous *middle stage*, northwest fractures were locally mineralized, but as a group do not contain significant mineral content.

Principal fissures persist across the district in both the metasediments and intrusives. Secondary structures (splits), however, may weaken and lose definition in the metasediments. Conversely, contact zones intersected by major fissures can be structurally important. Some fissures appear to have hosted several historic mines along their trend. For example, the Penobscot, Shannon and Blue Bird/Hickey mines are all on a major split of the Drumlummon vein (footwall vein). The Excelsior vein is probably the westward continuation of the North Star vein (Drumlummon mine). The Belmont-West Belmont vein represents a major split of the North Star-Excelsior trend crossing over to the Bald Mountain vein. The Bald Mountain vein probably is an extension of the Empire vein, although this correlation has been confused by *late stage*, post-mineral faulting (Empire Creek graben).

Splits are common along the major fissures. They can range from insignificant structures that rapidly pinch off, to significant ore-bearing veins. Horsetailing is locally present and blind veins (or splits) occur at depth. The principal structure in production at the Bald Mountain mine does not crop out, but from development and drilling is known to persist for at least 900 feet vertically and has not been bottomed. Other parallel, blind, ore-bearing veins have also been discovered by drilling.

Economic vein widths range from 2 - 4 inches, on the Knife Blade vein (Bald Butte), to 46 feet in the 9 Hour stope (Drumlummon mine). Average widths, based on available mine information, appear to have been 3 to 10 feet, although a number of veins (in particular, the Drumlummon) reportedly ranged more than 20 feet.

**Ore shoots**

Ore shoots are controlled by dilation along structure, fracture intersections and intersections with the Belmont porphyry dikes. In the Belmont and Drumlummon mines, mineralization was controlled by changes in strike or dip, with the best ore occurring on steeper segments. Knopf (1915) and Clayton (1938) both report the shifting or “wavy” character of the walls causing the vein to pinch or swell. Clayton (1938) further explained the southward pitch of the Drumlummon ore shoots:
The shifting of the hanging wall has been nearly straight down the slope of the underlie, and the curvatures, or wave lines of the fissure, pitch down obliquely to the south, corresponding generally with the pitch of the ore shoots in that direction.

Historically, structural intersections have been important. The original Bald Mountain — Cruse vein orebody was controlled by the mutual junction of the Cruse vein, Bald Mountain vein, and the stock - metasediment contact vein. Width reportedly reached 30 feet in this area. R. W. Raymond (Written Communication, 1895) stated, in contrast to Clayton, that the general southward trend of the Drumulumon orebodies, such as the Jubilee and Sampson shoots, was caused by the line of intersection of veins (Castletowns) joining the Drumulumon vein from the hanging wall. Widths of from 20 to 45 feet are recorded in some of these stopes. Intersections were also noted as important at the Bell Boy mine (Pardee and Schrader, 1933).

The importance of vein intersections with the Belmont porphyry dikes was recognized in early operations in the area of the Bald Butte — Empire Creek anticline. E. S. Ropes (Written Communication, 1919, 1935, 1936) emphasized the importance of this environment for gold deposition and indicated that veins intersecting a dike at the Bald Butte mine split into several strands, each of which was mined.

Individual ore shoot tonnages are not recorded for individual properties. However, at the Belmont mine, an average dilational ore shoot will contain from 50,000 to 75,000 tons. At the Drumulumon, the intersection that controlled the Sampson ore shoot below the 400-foot level was possibly on the order of 200,000 to 250,000 tons.

Between ore shoots, the veins are generally barren or weakly mineralized. At the Belmont mine, these include thin quartz-carbonate stringers in a gouge and crushed rock-filled structure. At the Drumulumon mine, barren parts of veins have been described as "angular rubbish" derived from the walls.

Bottoming within ore shoots is marked by a diminution in value. Belmont mine shoots will average from 0.6 to 1.0 ounce of gold in the upper zones, but commencing about midway vertically, values will progressively weaken (based on drilling) to 0.1 to 0.2 ounces of gold in the lower part. This change in tenor takes place with no apparent modification of the typical quartz-carbonate gangue. According to records, it would appear that bottoming was also similar at the Shannon, Gloster and Drumulumon mines. It is important to note, however, that at least in the Belmont mine, bottoming of one shoot did not preclude occurrence of another productive ore shoot at greater depth.

Hydrothermal alteration

Hydrothermal alteration of wall rocks differs on veins throughout the district. The Belmont veins locally show minor bleaching and kaolinization, but as a rule are enclosed by relatively fresh quartz diorite or metasediments. However, Pardee and Schrader (1933) report that at the Bell Boy vein, the hornstone (local historical term for hornfels) was considerably softened by the alteration of some of its constituents to a clay-like material. Recent work near the Castletown — Drumulumon vein intersection revealed pervasive kaolinization of the quartz diorite (Marvin Ratcliff, Personal Communication, 1990).

The Bald Butte and Empire Creek Tertiary centers are marked by striking alteration haloes. Both are characterized by silica flooding over the concealed cupolas (?) reflected by quartz outcroppings. This is succeeded outwards by intense development of biotite and orthoclase in the metasediment host rocks. In these areas, typical gray or gray-green Empire Formation shale has been converted to a dark (black) granular rock.

Persistence of mineral deposits

Gold mineralization in the Marysville mining district was emplaced in continuous fissures across an area of roughly 12 square miles. The resulting fissure veins are noteworthy for their persistence both laterally and at depth, and for providing consistently high gold grades throughout the district. A rough estimate of district gold production suggests that the district has yielded about 1.1 million ounces of gold valued at about $53 million.
A popular misconception of the district has been that the veins are (except for the Drumlummon mine) shallow and not persistent in the stock. Pardee and Schrader (1933) stated:

_The ore in all the veins occurs in shoots. High-grade ore was found above the 200-foot level, but in depth the ore rapidly decreases in value until the vein is no longer workable. None of the veins in the district except the Drumlummon, which is opened to the depth of 1,600 feet, is developed more than 500 feet below the surface._

At the time the above was written, the Gloster mine had been opened to a total depth of about 1,300 feet, completely in the stock. L. S. Ropes (Written Communication, 1933) pointed out the presence of high-grade gold ore on the deepest level of the Gloster mine. Knopf (1913) described a winze 750 feet below the lower tunnel (Gloster), and L. S. Ropes (Written Communication, 1935) further referred to $75 - $90 per ton gold values 500 feet below the lower tunnel (Gloster 500-foot level).

The depth of development at each of the principal mines is shown comparatively in Figure 2. The surface line in each case is shown at the approximate apex elevation. The stock or Tertiary cupola contacts are based on mine or drill data for the Drumlummon, Bald Mountain/Belmont, Bald Butte, Empire Creek and Gloster mines. The contact below the other mines, where noted, is based on magnetic modeling studies of the stock (David Blackwell, Written Communication, 1974).

Historically, the Bald Mountain property was developed to about the 6,100-foot elevation. Since 1986, however, deeper exploration in the stock has been conducted on the Bald Mountain vein system. This work has extended the known deposit in depth to at least the 5700-foot elevation, where between 3 and 4 feet of greater than 1 oz./ton gold is present in drill core.

The indicated vertical range for potential deposits in the district along principal fissures appears to be more than 2,000 feet. The highest occurrences are near the 6800-foot elevation at the Shannon and Bald Butte mines. The lowest level is based on the Drumlummon 1200-foot level (4,600 ft. elev.). Development of the Gloster mine apparently continued to the 5200-foot elevation (bottom ?), and the Bald Mountain is still open at the 5700-foot elevation. Principal structures clearly persist within the stock.

**Summary**

The geological development of the Marysville mining district apparently commenced shortly after renewed fault activity along the Lewis and Clark line (Wallace and others, 1985). Intrusion of the Marysville stock (79 Ma) and minor associated doming was followed by other Tertiary intrusive activity, perhaps coupled with compression from the southwest, to form the Bald Butte-Empire Creek anticline. Longitudinal and transverse (tensional) fracturing as defined by Wisser (1960) developed across the anticline into the stock. The longitudinal fractures subsequently served as channels for the Belmont porphyry intrusion. These were in turn faulted by the transverse structures.

Tertiary igneous activity underlying the Bald Butte-Empire Creek anticline began at about 49 Ma with emplacement of the Bald Butte quartz porphyry. This phase peaked in the 37 to 40 Ma period with emplacement of the Empire Creek pluton and crosscutting bodies southwest of Marysville and at Bald Butte. This activity was apparently accompanied by, or closely succeeded by, extrusion of a relatively extensive series of rhyolites, rhyodacites and dacites southwest of the anticline. Contact metamorphism accompanying the intrusions formed recognizable diopsid aureoles similar to that developed earlier around the stock. One of these encloses the Bald Butte center with the other extending southeast from Empire Creek to the Towsley Gulch area.

Epithermal mineralization followed at about 37 Ma. Solutions, guided by the fissuring, apparently migrated freely across the district. Orebodies formed wherever structural conditions were favorable, such as fracture/dike intersections, breccia zones, shattered areas or dilations. The possibility of some replacement mineralization may also be indicated, as P. Towndrow (Written Communication, 1982) refers to a "bedded" orebody mined in
Figure 2—Comparision of historic mines and mineralization in the Marysville mining district.
the hanging wall of the Drumlumnon vein. Gold and silver-bearing quartz-carbonate veins provided the main economic interest for mining. However, mineralogically, there is a zonal distribution within the district. Fluorite-molybdenite mineralization characterizes both concealed centers with the additional presence of a localized group of fluorite-bearing base-metal veins in the Towsley Gulch area.

The apparent source for mineralization is a series of Tertiary intrusions controlled along the axis of the Bald Butte-Empire Creek anticline. The fundamental control is the presence of longitudinal fracturing near or along the axial plane coupled with the proximity to regional faulting immediately west of the anticline. Mineral-bearing solutions migrating from one or more centers along the axial trend would have easily accessed the district-scale fissuring. The Towsley Gulch sector with its fluorite base-metal suite is suspected to reflect an underlying apophysis.

The geothermal system (heat-flow anomaly) was shown to be caused by hydrothermal convection along distributed fracture zones in a Cenozoic granite porphyry. Maximum temperatures of 100\(^\circ\) C were measured in the test well, and the modeled system is assumed to act as a simple reservoir with temperatures of about 95\(^\circ\) C at its upper surface. The present-day geothermal system may be the original Oligocene circulation system reactivated, if in fact it ever ceased, or a new one reopened in the same area (David Blackwell, Personal Communication, 1990). The Drumlumnon vein and related faults (veins) extending west along Ottawa Gulch are part of the geothermal circulation system.

The principal focus has been on ore emplacement east of the anticlinal centers along the direction of observable fracture development. However, zonally, there is no apparent reason not to expect mineralization to the west where structural conditions might have developed favorably.

The potential for mineralization appears favorable in structural settings above the 4700 - 5000-foot elevations. Orebodies occur equally along fracturing in the quartz diorite or overlying metasediments. It would appear that some of the early-day properties may have shut down, not because of lack of ore, but rather from lack of development caused by quick disbursements of dividends resulting in no funds for continued exploration or development.
Drumlummon mine

Introduction

The Drumlummon mine is located at Marysville, Montana, about 25 miles northwest of Helena (Figure 1). The original Drumlummon lode claim was staked by Thomas Cruse in 1876, and sold together with some adjoining claims to an English group in February 1883 for $1.5 million. The Montana Company, Ltd. was immediately formed and mining operations begun. The company was reorganized in 1892 as the Montana Mining Company, Ltd. The holdings were eventually transferred to the St. Louis Mining and Milling Company in 1910 following 20 years of litigation.

The mine was a significant producer during the latter part of the 19th century. Production during the Montana Company era was reported by Goodale (1915) as being 1,148,450 tons, with an average yield of $13.29 per ton (gold and silver).

Aside from its production, the mine was also the subject of a classic “apex rights” lawsuit. Litigation commenced in 1889 and eventually terminated in 1909 when the St. Louis Company was awarded a damage judgement of $203,102.02 plus costs of $2,387.25.

The unfortunate positioning of claims relative to the Drumlummon vein, and resulting litigation, provides the focus for this historical review. Mine geology and production history will be summarized, with some final notes on subsequent activities by the St. Louis Company.

The Drumlummon mine was centered within nine patented lode claims plus three fractions (patented). Most of these were owned by the Montana Company. Exceptions were the St. Louis claim (St. Louis Company) and the Hopeful (fraction). The pertinent claims are shown in Figure 3 and are listed below in order of patent number:

<table>
<thead>
<tr>
<th>Claim</th>
<th>M.S. No.</th>
<th>Patent No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drumlummon</td>
<td>604</td>
<td>3240</td>
</tr>
<tr>
<td>Marble Heart</td>
<td>1515</td>
<td>11529</td>
</tr>
<tr>
<td>St. Louis</td>
<td>1089</td>
<td>12338</td>
</tr>
<tr>
<td>9 Hour</td>
<td>1705</td>
<td>14075</td>
</tr>
<tr>
<td>Hopeful</td>
<td>1989</td>
<td>15589</td>
</tr>
<tr>
<td>Maskelyne</td>
<td>1781</td>
<td>22556</td>
</tr>
</tbody>
</table>

It is important to note that overlaps by the Drumlummon, Marble Heart and 9 Hour surveys onto the St. Louis claim were disallowed at the time of patenting. The St. Louis claim was patented in its entirety.

Geology

The Drumlummon property, which includes several strong fissure veins, extends along and encompasses the northeast-trending contact between Cretaceous quartz diorite (Marysville stock) on the west, and Precambrian Belt metasediments to the east (Figure 3). The latter were termed hornstones and slaty shales by Barrell (1907).

Veins

Drumlummon vein

The Drumlummon vein is the principal structure with development more than 3,000 feet along strike and to a depth of 1,600 feet. Ore values generally bottomed at depths of between 800 and 1,000 feet.
Figure 3—The Drumlummon and surrounding lode claims (from Goodale, 1914).
The vein strikes N 15° and dips 65° to 80° east. The vein tends to parallel the stock-metasediment contact and has been described as occurring within the contact zone. Generally, the intrusive occurs in the footwall; however, the contact is not regular in configuration and quartz diorite apophyses extend eastwards into the hanging wall metasediments.

Goode (1915) stated

... In width the lode varies from 15 to 25 ft. in its widest and productive portions, to less than an inch at one observed point in its pinched and barren region. For hundreds of feet along its strike it shows between well-defined walls from 1 to 3 ft. of soft material, almost free from quartz...

Weed (1903) described the Drumlummon vein as

... a fault plane with white opaque quartz inclosing angular fragments of black, green and drab slates, which are sometimes distinct and unaltered and at others have been much decomposed. Where the orebodies are found the replacement has been complete and the former presence of the fragments is only recognizable by the outlines of the banded quartz... This vein, which is the largest and the most productive in the district, consists in its lower levels of a mass of angular rubbish, derived from the walls of the fissure, and in places cemented by quartz, in other places still retaining its original character... It may also be said that the ore shoots were well defined and the intervening vein matter barren and unworkable.

Ore shoot widths were good. G. H. Robinson (Written Communication, 1887) reported that the Jubilee shoot (400-ft level) had a maximum width of 32 feet and would average 20 feet across a level intercept of 100 feet. Similarly, maps of the 9 Hour stopes record widths of at least 45 feet.

Major ore shoots along the vein have a characteristic rake to the south (Figure 4). Several of these formed near intersections with foot or hanging wall structures. This was observed by R.W. Raymond (Written Communication, 1896) who made the following correlations: Pixley No. 1 shoot—North Star/Empire veins, No. 1 South shoot—Old Castleton vein, and Sampson shoot—New Castleton vein.

The rich 9 Hour ore shoot at the south end of the mine has not been directly correlated with a specific vein junction. However, it seems to occur where the major Drumlummon fissure horsetails into several strands striking westward into Ottawa Gulch.

Nothing is known of the St. Louis vein junction. As projected it would have existed in that part of the mine known variously as "disputed", "contested", or "barren". The area in question underlay the apex and was closed by a court injunction. A possible, projected correlation might, however, be made with the Jubilee stopes.

**North Star vein**

The North Star vein is located in the footwall of the Drumlummon vein in the northern part of the property. The vein strikes S 80°W and dips near vertical. This deep vein was the most productive with stoning extending down to the 1200-foot level. Originally, this structure was thought to be the same as the one in the North Star claim leading to nomenclature confusion (Goode, 1915). Subsequently, the latter was revealed to be correlative with the Castleton vein.

**Empire vein**

The Empire vein occurs in the hanging wall of the Drumlummon vein nearly opposite the North Star vein with a strike on N 35°E. Early opinions varied regarding its relationship to the North Star and Drumlummon veins. Was it correlative with the North Star, and if so, was it pre- or post-Drumlummon in age? Goode (1915) seems to support the view that it is a separate, silver-rich structure in the hanging wall, mineralogically quite different from the North Star, which was silver poor.
Castletown vein

The Castletown vein is similarly located in the hanging wall of the Drumlummon. It strikes about N40°E and dips 70°S. Near the Drumlummon junction, this structure divides into two splits (strands) known as the Old Castletown (North) and New Castletown (South) based on time of discovery. Mining was conducted on these structures to the 1000-foot level.

St. Louis vein

The St. Louis vein lies in the footwall of the Drumlummon vein within the claim of the same name. This structure strikes about S40°W and dips steeply south (near vertical). Production data for this vein is not well documented. It was reportedly mined near surface and, although recommended, was apparently never tested in depth.

Mining

Montana Company era

Thomas Cruse located the Drumlummon claim in 1876 on the site of an earlier lapsed location. Working independently, he drove a 200-foot tunnel crosscutting the Drumlummon vein at about 140 feet, plus completing an additional 361 feet of drift (Goodale, 1915). Cruse installed a 5 stamp mill and mined about 6,000 to 7,000 tons of ore (Goodale, 1915).

The property was sold by Cruse to an English syndicate in February 1883, based upon an examination by an English engineer, John Darlington, in November 1882. Cruse received $1.0 million plus shares worth another $500,000.

The Montana Company was formed and intensive development begun under the direction of George Attwood, mine manager. The Maskelyne tunnel (400-foot level), named for N. Story Maskelyne, Chairman of the Board, was started immediately and Cruse’s 5 stamp mill was increased to 10 stamps.

Mine development proceeded smoothly until 1884 when production grade and income dropped sharply. Accusations were made concerning the validity of John Darlington’s original report and a Committee of Inquiry was appointed. The outcome was that Darlington’s work was vindicated and the mine manager was released because of poor financial management and lack of exploration. The Board was also reformed with five new members appointed on December 16, 1884. Rawlinson T. Bayliss and H. Bratnober were appointed general manager and mine superintendent, respectively. John Darlington was named consulting engineer and in 1888 was elected to the Board.

Operations became successful under the new team’s direction. Exploration, development, and stoping were pushed in the next few years with operations mainly concentrated in the northern portion of the mine above the 700-foot level. The longitudinal section accompanying the 1887 Annual Report identified stopes in the following ore shoots: Pixleys 1 to 4, No. 1 and 2 south, and Sampson (above the 400-foot level south). Mention was also made that the Jubilee shoot had just been opened on the 400-foot level, and that the latter was advancing south of the shoot on structure towards the 9 Hour shoot, with no knowledge of what to expect between them.

The original 10 stamp mill had, by this time (1887), been augmented with the addition of a 50 stamp mill (1885) and a 80 stamp mill (1887) bringing the total to 120 operating stamps. The mine was reported to have had 360 men employed with a total of 30 air drills, 15 being used for exploration.

Operations proceeded rapidly in the next few years. By early 1892, the No. 1 shaft had reached the 1600-foot level, the Sampson shoot was mined to the 80-foot level and stoping was active in the Old Castletown and North Star/Empire veins.
Disaster struck on May 8, 1892 (Goodale, 1915). The No. 1 shaft was lost to fire which started in the 1200-foot level station and quickly engulfed timbering up to the 400-foot level station. The shaft station and headframe timber were saved, but it was two years before the shaft was fully rehabilitated. Economically, loss of the shaft had serious consequences. Production was curtailed and problems were further compounded by the silver market collapse in 1893. The Annual Report for that year indicated a 21 percent drop in the market value of product. The multiple problems resulted in the company being reorganized as the Montana Mining Company, Ltd.

By 1894, the north end of the mine had been heavily developed and mined, and the No. 2 shaft was completed to the 1200-foot level. The 9 Hour ore shoot development had begun, although the 400-foot level south had apparently not yet reached the area. Ore reserves appear to have been of some concern at this time as R. W. Raymond and T. A. Rickard were engaged to study the mine and propose suggestions for future guidance. Their report, in which they recommended deeper development, was submitted in 1896. Subsequently, the latter part of the 1890s were busy years. By December 31, 1900, the 400, 700, 1000 and 1600-foot levels had been driven to the 9 Hour ore shoot and considerable mining was carried out (Figure 4).

Shortly after the turn of the century, unfolding legal actions became a major concern as court judgements were being rendered. In 1910, the situation continued to deteriorate and eventually lead to the Montana Company abandoning the property to the St. Louis Company. Production, which had averaged about 61,000 TPY from 1884 to 1899 (1892 excluded) began declining. By 1904, it was less than 10,000 TPY, and appears to have essentially ceased after 1905 (P. Trowdrow, Written Communication, 1986).

Total production and development during the Montana Company era (from Goodale, 1915).

| Tons mined | 1,148,450 |
| Total net yield | $15,285,825 |
| Ounces gold | 568,898 |
| Ounces silver | 4,982,942 |
| Total development | 123,500 foot (23.4 mil.) |

**Litigation**

The circumstances which led to the eventual demise of the Montana Company's operations were rooted in the unfortunate positioning of the boundary between the St. Louis Company owned claim and the Montana Company's property. The eastern side line of the St. Louis claim roughly approximates the outcrop of the Drummemon vein (Figure 3). The vein averaged 15 to 25 feet wide in its productive zones (Goodale, 1915). These figures, however, were in contrast to the direct testimony of W. P. Jenney, expert witness for the St. Louis Company. Testifying in U.S. Circuit Court on June 6, 1905, Jenney, a consulting geologist, described the Drummemon vein as varying in width from about 45 feet where it entered the St. Louis claim on the northeast to a minimum of about 5 feet southerly before again swelling to about 44 feet near the boundary with the 9 Hour claim on the south. Where the vein traversed obliquely across the St. Louis claim boundary to the north and south, substantial intervals resulted wherein the vein actually straddled the line. The vein was determined during litigation to apex completely within the St. Louis claim (footwall and hanging wall) for a distance of 610 feet. The footwall crops out for nearly 1,300 feet within the claim commencing at the northeast corner.

Early operations, centered around No. 1 shaft for the most part, did not impinge on this boundary. However, as work eventually progressed south beyond No. 2 shaft, the critical apex zone was penetrated on all levels (Figure 4). This penetration was apparently already underway by 1889 as the Montana Company noted in its Annual Report that the St. Louis Mining and Milling Company had applied for an official survey of a portion of the Montana Company's workings.

Litigation between the Montana and St. Louis companies quickly developed into a lengthy ordeal marked by complaints and counter complaints. A number of lawsuits were filed by both parties in Helena District Court, with the more significant ones being transferred to the U.S. Circuit Court. The litigation that followed was inten-
sive and complex. The details of this legal saga, which ultimately reached the State Supreme Court, The Circuit Court of Appeals (five times) and the U.S. Supreme Court (four times) was documented by Goodale (1914).

The U.S. Circuit Court records (dockets, National Archives, Seattle, WA) for the early 1890s show five cases ("causes") listing the St. Louis Company as plaintiff vs. the Montana Company and R.T. Bayliss and et al. These are:

<table>
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<th>Case No.</th>
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<th>Settled</th>
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<tbody>
<tr>
<td>99</td>
<td>November 17, 1890</td>
<td>May 26, 1893</td>
</tr>
<tr>
<td>249</td>
<td>August 31, 1892</td>
<td>December 1, 1898</td>
</tr>
<tr>
<td>286</td>
<td>August 19, 1893</td>
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</tr>
<tr>
<td>290</td>
<td>September 15, 1893</td>
<td>January 17, 1894</td>
</tr>
<tr>
<td>291</td>
<td>September 16, 1893</td>
<td>August 12, 1909</td>
</tr>
</tbody>
</table>

In essence, the problem was simply reduced to a question of who controlled the vein down dip beneath the apex within the end line planes of the St. Louis claim. An early complaint brought by the St. Louis Company in 1893, seeking $2.0 million in damages for wrongful removal of ore within the end line projections, was denied due to insufficient proof of apex position (W. Mayger, Written Communication, 1901).

Subsequently, extensive work was conducted by the St. Louis Company to define the foot and hanging wall positions along with commencement of mining in that portion of the 9 Hour ore shoot within the St. Louis claim. This latter activity brought renewed confrontation and filing of additional lawsuits.

A parallel issue at this time was resolution of ownership to a 30-foot parcel of ground located at the south end of the St. Louis claim known as the "compromise strip" (Figure 3). This portion of ground, overlying the apex of the vein and the rich 9 Hour ore shoot, had been promised by the original locators of the St. Louis claim under court direction to the former 9 Hour claim owners prior to acquisition by the Montana Company. The St. Louis Company ownership had failed to grant this title and the issue was finally settled in 1898 by the U.S. Supreme Court and title given to the Montana Company on July 1, 1898.

The companies were back in court in August 1899. The St. Louis Company was once more suing the Montana Company, this time for $250,000 in damages for ore wrongfully removed from below the apex within the end lines. The jury found in favor of the St. Louis Company on August 12, 1899, and awarded damages of $23,209.00 (W. Mayger, Written Communication, 1901). The verdict also established the apex position, officially recognizing that 610 feet of strike was wholly within the St. Louis claim commencing at a point 520 feet south of the northeast corner.

The verdict was appealed by the Montana Company to the Appellate Court in San Francisco. The Appellate Court affirmed the lower courts judgement and emphasized that a mining claim can have but two end lines, and that, end lines having been once established, they become the end lines for all veins found within the surface boundaries. This statement was in response to an effort by the Montana Company to reinterpret the end lines of the St. Louis claim, recognizing the Drumulummon vein, rather than the St. Louis vein as originally patented. More importantly, the Appellate Court issued a ruling stating that where a vein straddled the boundary, the right to the apex would rest with the senior locator regardless of dip. Prior to this time, such recognition had only been accorded in vertically situated veins. This ruling obviously placed the Montana Company in a vulnerable position, and lead to additional legal maneuvering, eventually resulting in a reversal of this decree by the U.S. Supreme Court.

The case was retried before a jury commencing on May 31, 1905, and appealed to the U.S. Supreme Court. This resulted in issuance of a mandate by that court on February 27, 1907 directing that a new trial be undertaken. After some delay, this trial commenced on June 21, 1909.

The long period of collective litigation finally ended on August 12, 1909 (20 years), when the court awarded the St. Louis Company damages of $203,129.02 plus $2,287.25 court charges. This represented the value of 1,912 tons of ore removed in 1893 with accrued interest of 8 percent. Ironically, these damages were based upon a reinterpretation of apex rights, wherein the "compromise strip" was adjudged to be part of the 9 Hour claim,
rather than the St. Louis claim, as it was patented prior to being transferred, and therefore junior in ownership. The Montana Company was not disposed to (or could not) pay the judgment. The pumps had already been pulled in 1901, allowing the mine to flood to the 400-foot level, with production limited to that level (P. Townsdrow, Written Communication, 1985). The property was abandoned and passed into St. Louis Company ownership in 1910.

St. Louis Company era

The St. Louis Company was financially drained by the years of litigation and appears to have been unprepared, or possibly overwhelmed by events. In any event, the company never mounted a serious mining effort after gaining the mine, although some minor production was maintained for a few years. Only minor lessee activity is recorded (L.S. Ropes, Written Communication, 1919, 1933, 1935, 1936), totaling about $1.0 million in value mined from above the water table (400-foot level).

The St. Louis Company, however, did make an effort during the 1930s to acquire a loan from the Reconstruction Finance Corporation (RFC). Their proposals included mine rehabilitation, new development and mining of projected reserves left in the 9 Hour sector, the "disputed zone", and the St. Louis vein. The application was denied as RFC engineers considered the Drumblummon structure on the 400-foot level to be a "barren zone". L.S. Ropes (Written Communication, 1936) vehemently protested this judgement (to no avail) in a correspondence to O.B. Suck, President of the St. Louis Company, pointing out the refusal of RFC to consider expert witness testimony regarding deeper levels.

The Drumblummon was eventually leased to the Montana-Rainbow Mining Company on October 9, 1941. The mine was dewatered to the 700-foot level and rehabilitation and mining commenced (Wade, 1945). Efforts were successful, including discovery of new reserves, as well as additional production from previously known areas. The program also included test drilling of vein walls with some limited work immediately south of the Jubilee area in the "disputed zone" on the 400 and 700-foot levels. Detailed results of this work are not known, although the few holes recorded would not by themselves have been sufficient to test this area. Gold mining was curtailed during World War II, but production of silica flux for the East Helena smelter was continued. The Montana-Rainbow operations ended in 1951 when their mill was destroyed by fire. No production records for this period are available.

The most recent efforts to reopen the mine commenced about 1980 when the property was leased by Goldslif Ranchers Company who were succeeded by Goldslif Mining and Milling Inc. of Denver, Colorado in April 1981. They were joined by Consolidated Paymaster Resources Ltd. of Vancouver, British Columbia (50%) in April 1983. This arrangement apparently dissolved in 1984 to be succeeded by Simonyi Gendele Company, which in turn dropped interest. Early in the Goldslif years, considerable effort was made in reopening the 400-foot level (Maskelyne tunnel) to the No. 1 shaft, rehabilitating a nearby cyanide mill (erected by J.B. White and Associates in the mid-1970s to treat the old Drumblummon tailing), and undertaking some exploration drilling. This latter work included a systematic, but unsuccessful, look at possibilities for new ore in the 400-foot level sector at the north end of the mine. The early efforts floundered because of financial problems. Later joint-venture efforts failed to revive the project and the property was returned to the St. Louis Company.

Comments

How extensive or complete was mining and development by the Montana Company beneath the disputed apex zone? Such work was prohibited by court injunction, according to R. T. Bayliss (Written Communication, 1893).

There has not been any important change in the aspects of the suits now pending since my remarks to the shareholders at the last meeting, with the exception that we have instituted a suit in equity against the St. Louis Mining and Milling Company and Charles Mayger to enforce the conveyance of title to the 30 foot strip of the 9 Hour claim known as the "Compromise Ground". . . This protracted litigation is undoubtedly a great source of annoyance and interference with our legitimate operations,
as we are precluded, pending the determination of the points of issue, from working in our own
ground within the area covered by the pretended rights of our opponents.

How well did the Montana Company adhere to this injunction? In all fairness, seemingly quite well. The
transitional apex zones were apparently open to question (operationally) until the controversial Appelate Court
ruling of October 8, 1900 temporarily gave these areas to the senior locator. Prior to that time the Montana Com-
pany was mining the 9 Hour ore shoot, and before that had worked the Jubilee shoots.

Likewise, in regard to the restricted 610 feet of apex, Walter P. Jenney (Written Communication, 1899) who
inspected the mine and testified as an expert witness for the St. Louis Company, responded:

In making any estimate of the value of this section of 610 feet of the Drumlummon lode, it should be
remembered that the Montana Company have for years past carefully avoided doing any work
whereby ore bodies might be developed in the ground in controversy. The workings show this,
wherever in drifting in this part of the mine the indications in the vein were favorable for ore, it is
seen that the drift was turned off to one side into barren rock. Nowhere are cross cuts run, raises
made or winzes sunk, though in places on the 700 and 1,000 foot levels in the section mentioned, the
indications for ore are such as to induce a miner searching for it in good faith, to explore the entire
width of the vein from wall to wall.

John R. Parks (Written Communication, 1901), who also appeared as an expert witness for the St. Louis
Company reiterated the same conditions, as noted.

. . . but for several hundred feet between the south end of the “Jubilee” chute and north end of the
“Nine Hour” chute all the workings lie east of the hanging wall of the vein, that is, entirely outside of
the vein. In other words, several hundred feet of the vein in the ore bearing zone between the
“Jubilee” and “Nine Hour” chutes has not been exploited except at great depth where some of the
ore was found, and the mineralization of the vein between these chutes indicate the occurrence of an
ore chute above. This undeveloped portion of the vein lies entirely within the limits of the six hundred
and ten (610) feet of the vein conceded to belong to the St. Louis Company.

A portion of a statement by R. W. Raymond, attorney, published as part of Goodale (1914) follows below,
and perhaps forms a fitting summary to this narrative.

This contest, from beginning to end, was waged by the St. Louis Company against a company
of British capitalists who had purchased the property, and invested their money for its development,
in entire good faith, and who never undertook to do more than defend what they had bought and
paid for, and honestly believed that they owned. That this company, after many years of litigation,
was finally forced to submit to a practical confiscation of its supposed property, is chargeable, not to
the action of its adversaries, who doubtless claimed only that to which they thought themselves
legally entitled, but to the law which made such conflicts possible. The victims of the law in this case
were those who had sedulously sought to obey it.

Today the Drumlummon mine stands idle. The mystique, however, still surrounds it and people still
speculate about its potential. The questions also remain—did the Montana Company deliberately bypass
potentially promising ground as witnesses reported, or is the “disputed zone” in truth a “barren zone”? Would the
Montana Company have persisted in the protracted litigation if they had not felt it worthwhile? Perhaps posterity
will provide an answer.
References


Wade, W.R., 1945, Reopening the Drumlummon mine: Mining World, p. 27.


Appendix

Notes On Principal Mines

Drumlummon Mine

Location: Sec. 36, T12N, R6W

History: Located by Thomas Cruse in 1876; sold to Montana Company in 1883; acquired by St. Louis Mining and Milling Company in 1910; leased/operated by Montana Rainbow Company 1941-1950 (W. Wade, Manager).

Production: $29,000,000 (gold-silver); total tons mined approximately 1.1 to 1.2 million. Average grade 0.5 oz./ton gold; high values to several ounces per ton common in early production. Cutoff was reportedly at $7.00.

Elevations: Apex 6,000—6,100 feet.
Bottom economic mining approximately @ 1200-foot level (4,600 ft.)
Deepest development 1600-foot level (4,200 ft.)

Geology: Host rocks - contact zone between metasediments and quartz diorite.
Drumlummon vein strikes N15°E with 65° to 75° southeast dip. Configurations sub-parallel to parallel with contact zone.
Several northeast striking intersecting structures of economic importance.
Average width ranged 15 to 25 feet (up to 45 feet).
Major ore shoots controlled by vein intersections.
Free gold, silver (freibergite, pearceita); lesser amounts of chalcopyrite, galena, sphalerite and pyrite.

Development: Extensive underground workings (approximately 23 miles); stamp mills at peak totaled 112.
Amalgamation and cyanidation.

Bald Butte Mine

Location: Near Bald Butte townsite; NW 1/4, Sec. 10, T11N, R6W.

History: Early history unknown. Apparently located prior to 1886; operated with intermittent shutdowns from 1890 to 1917. Bald Butte Mining Company was operator in later years. L.S. Ropes was superintendent in early 1900s.

Production: $3,500,000 (gold-silver)

Elevation: Apex about 6,800 feet; lowest level approximately 6,300 feet.

Geology: Interbedded microdiorite sills and metasediments cut by northwest striking dike of Belmont porphyry (60° to 70° SW dip).
Complex series of rhyolite quartz porphyry intrusions in depth with silica cap extending to surface on southwest slope.
Principal production from eight veins in Genessee claim plus Albion vein. Multiple veins may represent a loop structure formed at dike intersection. Width ranged from 2 to 4 inches of high grade (Knifeblade vein) up to 22 feet.
Ore occurred along vein in dike or footwall of dike.
Free gold with silver plus lesser amounts of quartz, fluorite, molybdenite, galena, sphalerite and pyrite.

**Development:** Presumed to be relatively extensive with 40 stamp mill in 1905.

**Gloster (Piegan) mine**

**Location:** SW ¼, Sec. 27, T12N, R6W

**History:** Patented by Martin Mitchell, Thomas Cullinan and John Fogarty. Subsequently operated in succession by Boston and Montana Mining Company (about 1880-1890); from 1916 to 1923 by the Barnes-King Development Company. The Longmaid family acquired and operated the Piegan portion starting in April 1903.

**Production:** $3,500,000 from ore plus $250,000 from tailing. Total tons mined about 400,000. Barnes-King Development Company mined 91,354 tons which grossed $718,194. Average Barnes-King stope costs were $3.23/ton.

**Elevation:** Apex 6,200 to 6,300 feet.
Gloster shaft collar 5,790 feet.
800-foot level—5,000 feet elevation (approximately). This level was driven from a 300-foot winze below the 500-foot level (Knopf’s 750-foot level, 1913)

**Geology:** Quartz diorite (Marysville stock)
N55°W vein which appears to split to southeast, steep northeast dip.
Width ranges from 3 to 12 feet.
Original Gloster ore shoot reportedly 600 feet deep and 800 feet long.
Vein composed of quartz (some amethystine) and carbonate. Free gold (?) near surface with chalcopyrite and pyrite apparently increasing with depth.

**Development:** Approximately 12,000 to 14,000 feet; 60 stamp mill with amalgamation (early period); cyanide plant during Barnes-King era.

**Bald Mountain (Cruse) mine**

**Location:** SW ¼, Sec. 35, T12N, R6W

**History:** Located by Thomas Cruse, August 7, 1875; owned and operated by him until his death on December 24, 1914.

**Production:** $3,500,000. Approximately 250,000 tons.
Cutoff about 0.25 oz. gold per ton.

**Elevation:** Apex 6,700 feet.
Deepest level 6,000 feet.
Deepest drilling 5,700 feet (ore).

**Geology:** Metasediments overlying quartz diorite.
Contact dips gently to southwest within the mine complex, near east - west veins with splits dipping generally 70° south to overturned.
Average width ranges from 2 to 5 feet (up to 15 feet).
Ore shoots dilational (controlled on steeper segments). Principal historic ore shoot appears to have been vein intersection controlled in contact zone.
Free gold, silver (acanthite); trace amounts of chalcopyrite, pyrite and galena in depth.
Quartz, carbonate and adularia as gangue.
Development: Approximately 12,000 to 15,000 feet; 6 levels; 20 stamp mill cyanidation used.

Shannon mine

Location: S ½, Sec. 3, T11N, R6W.

History: Discovered about 1886 by Pat Shannon; sold to Barnes-King Development Company in 1916; produced until 1923.

Production: $2,700,000. Barnes-King era, 210,307 tons worth $1,518,137.

Elevation: Apex 6,800 feet.

Geology: Helena Formation limestone host at or near Belmont porphyry dike intersection. Vein near east-west; 70° south dip; faulted to east. Widths range from 7 to 14 feet; averaged 12 feet in 300 and 400-foot level stopes. Typical quartz-carbonate ore; contained some sulfide in depth.

Development: Systematic, shrink stopes were backfilled with waste; ore was taken by gravity aerial tram to Gloster mill (13,800 ft. in length).

Belmont mine

Location: SW ¼, Sec. 35, T12N, R6W

History: Located by William B. Frue and Nate Vestal in 1878; acquired and operated by John Longmaid family from 1898 until July 1909 when purchased by T. Cruse.

Production: $2,500,000

Elevation: Apex 6,700 feet
Deepest development 6,100 feet.

Geology: Metasediments overlying quartz diorite similar to adjacent Bald Mountain mine. Northwest striking vein with hanging wall splits striking west; dips steeply south or southwest. Drill information indicates various veins ranging from 2 to 10 feet in width. Ore shoots and mineralization believed similar to Bald Mountain vein.

Development: Approximately 10,000 to 12,000 feet; 30 stamp mill; amalgamation and cyanidation.

Empire mine

Location: NE ¼, Sec. 33 and NW ¼, Sec. 34, T12N, R6W

History: Empire vein located by John Stemple in 1880; major development by Golden Leaf Company, Ltd. (1880 to 1990s).
M & L Vein discovered by Mike Lynch and later owned by Owen Byrnes.

Production: $2,500,000; reportedly averaged $30/ton in gold, silver, copper and lead.

Elevation: Apex about 6,500 feet.
Lowest level at about 5,700 feet.
Geology: Empire Formation shale; interbedded microdiorite sills.
Smithville, Empire and ML veins form main mine area with Whippoorwill vein located a short distance to north; all dip steeply south except for Whippoorwill which dips to north.
Smithville and ML veins offset by post-mineral graben faulting.
Ore shoot dilational and intersection (?) controlled.
Quartz (some amethystine), carbonate gangue, free gold with silver, also economically important galena plus lesser malachite, chrysocolla and cerussite.

Development: Relatively extensive; 60 stamp mill; cyanide.

Penobscot mine

Location: SE ¼, Sec. 4, T11N, R6W.

History: Located by Nate Vestal about 1873 (?). Acquired and operated 1879 to 1885 by Michigan Company (William B. Frue); incorporated into Penobscot and Snow Drift Mining Company and operated by Longmaid family until early 1900s.

Production: $1,230,000.

Elevation: Apex 6,700 feet.
Lowest level (?) about 6,500 feet.

Geology: Metasediments cut by northwest striking Belmont porphyry dike.
East-northeast striking veins (4); dipping 65° to 80° northwest.
Widths range from 3 to 4 feet with high-grade “scales” similar to Bald Butte.
Ore occurs in veins at dike intersection.
Typical quartz-carbonate ore with free gold and silver.

Development: Moderate; 10 stamp mill

Towsley Gulch (Bell Boy) mines

Location: NW ¼, Sec. 5, NE ¼, Sec. 4, T11N, R6W.


Production: $650,000 from Bell Boy. No production data from other holdings. Bell Boy ran $10 to $50 gold with 8 to 30 percent lead.

Elevation: Apex about 6,400 feet.
Lowest level developed about 5,700 feet.

Geology: Empire Formation shale cut by Belmont porphyry dike.
Three major structures: Towsley-Shakopee and Nile-Earthquake veins strike N70°E and dip 70° south. Bell Boy vein (split of Nile) strikes S50°E dipping 70° southwest.
Widths range from 8 to 30 feet.
Ore shoots occur as large quartz and sulfide cemented breccia zones, as well as mineralized strands, which may shift from footwall to hanging wall of major structure.
Diverse mineral suite: gold, silver, cerussite, calamine, copper oxides, iron oxides, galena, chalcocypirite, and fluorite.
Minimal quartz (paragenetically late); little or no carbonate.

Development: Moderate
Blue Bird - Hickey mine

Location: E ¼, Sec. 3, T11N, R6W.

History: Owned by St. Louis Mining and Milling Company.

Production: $600,000; reportedly averaged $15 ton; stope section samples ranged from 0.3 to 1.5 ounces of gold per ton.

Elevation: Apex 6,700 feet.
Lowest level 6,440 feet.

Geology: Empire Formation shale and Helena Formation limestone cut by at least three Belmont porphyry dikes.
Vein offset by Shannon and Mount Pleasant faults.
East-west vein dipping 60° to 70° south; interpreted to be the westward extension (continuation) of Drummond footwall structure.
Blue Bird-Hickey orebody controlled at dike contact; vein appears to split (loop ?) at dike.
Widths range from 4 to 12 feet.
Typical quartz-carbonate with free gold and silver.

Development: Moderate
Back pocket contents

Sheet 1—Geologic map of the Marysville mining district, Montana

Sheet 2—Geologic Cross Sections