THESIS

ABYSMAL LUCK IN THE ABSAROKAS: GOLD REEF – A LATE $19^{\rm TH}$ EARLY $20^{\rm TH}$ CENTURY MINING LOCALITY IN NORTHWESTERN WYOMING

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In partial fulfillment of the requirements

For the Degree of Master of Art

Colorado State University

Fort Collins, Colorado

Fall 2006

Colorado State University

May 9, 2006 WE HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER OUR SUPERVISION BY ANDREW CHARLES MUELLER ENTITLED ABYSMAL LUCK IN THE ABSAROKAS: GOLD REEF - A LATE 19th EARLY 20th CENTURY MINING LOCALITY IN NORTHWESTERN WYOMING BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS.

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Abstract of Thesis

ABYSMAL LUCK IN THE ABSAROKAS: GOLD REEF – A LATE $19^{\rm TH}$ EARLY $20^{\rm TH}$ CENTURY MINING LOCALITY IN NORTHWESTERN WYOMING

This thesis examines Gold Reef, a small mining locality in the Absaroka Mountains of northwestern Wyoming. Gold Reef was occupied from approximately 1895 to 1914. The mining archaeology of Wyoming has received only minimal research to date and this paper seeks to partly redress this imbalance. The primary goals of this study are to provide a description of the sites at Gold Reef, compare these sites to other contemporary mining location in the Wyoming Absaroka Mountains, discuss the economic and social forces shaping the development of mining at the time and to verify local indigenous knowledge that the activities at the sites were actually fraudulent. To address these issues the historic, geologic, archaeological and economic aspects of the mining activities in the area are explored and discussed. Discrepancies in the historic records along with the lack of viable economic mineral deposits at the location indicate that the site was indeed an attempt to defraud either investors or the company's management, although alternative explanations for the archaeology are briefly explored.

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Acknowledgements

I would like to thank the people who helped with this project. The support and assistance of my committee made this study possible. Dr. Todd provided the field crew, helped find information from Meeteetse locals about the area, and lent me some of his technical expertise. Dr. Van Buren provided theoretical direction and help with the historical archaeology basis of the study and Dr. Ore was a great help in finding sources of information on mining history and other possible interpretations of the Gold Reef activities. My fellow graduate students discussed the project over many beers and provided a great deal of insight and support during the writing of this paper. Special thanks go out to Bill Reitze for running the field crew for me while I attended to various small projects around the Gold Reef cirque. Finally, the 2003 field crew worked tirelessly without major complaint despite hiking up and down "Widowmaker" daily for ten straight days. I would also like to thank the Meeteetse Museum for helping me find information on both Gold Reef and Kirwin and Mr. Dunrud for his insights on the geology and history of the area.

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CHAPTER 1: INTRODUCTION

This thesis examines Gold Reef, a small-scale mining operation in the Absaroka Mountains of northwestern Wyoming. The immediate project area has received only minimal research consisting of a short site report conducted by a local avocational historian. The goals are to provide a basic description of the sites in the Gold Reef cirque, compare the mining activities at Gold Reef with other mining operations in Wyoming's Absaroka Range, study the economic and social forces that shaped the development of the operation, and determine whether Gold Reef actually possessed any significant economic potential or was merely an attempt to bilk the company investors and management located in Chicago.

This thesis is organized into six chapters. The introductory chapter provides an overview of the project area and the hypothesis examined in this paper. The second chapter addresses the research methodology and theoretical perspective used in this study. Chapter 3 reviews the geologic history of the Absaroka Range and the types of economic minerals noted at mining localities throughout the region. The fourth chapter summarizes the history of mining in Wyoming and the economic conditions shaping mining activities in the late 19th and early 20th centuries. Chapter 5 presents information on the four sites located within the Gold Reef district. Chapter 6 discusses the information presented in the previous chapters, and synthesize these data to develop a hypothesis of human behavior in the Gold Reef cirque.

LOCATION



Figure 1.1. Map showing the location of Gold Reef in relation to Wyoming. Base maps from <u>http://seamless.usgs.gov/website/seamless/viewer.php</u> and http://wgiac2.state.wy.us/html/wsdc_index.asp

The current Gold Reef project was initiated as part of the Greybull River Impact Zone project located in the Shoshone National Forest (Figure 1.1). The western portion of the project area was originally part of the Yellowstone Park Forest Reservation set aside in 1891 by President Harrison as the first forest reserve in the Rocky Mountains. This was undertaken to help "buffer" impacts that might detract from the newly formed Yellowstone National Park (Hague 1899). This has limited impacts within the project area making the project area an unusually "pristine" environment in which to study past human behavior.

Gold Reef was a small mining operation in Park County, northwestern Wyoming, approximately forty eight kilometers from Meeteetse, Wyoming. The Absaroka Mountains form the western margin of the Bighorn Basin, one of the major geographic divisions of Wyoming (Knight 1994; Fenneman 1931; Thornbury 1965). The Gold Reef complex consists of four distinct mining sites scattered across the eastern portion of a cirque located at the head of the main branch of Jack Creek. One of these sites is a tunnel with habitation structures, one is a tunnel that may have had a cabin, one is a tunnel without associated structures, and the final site is a campsite that may have been the original survey camp for the area. The sites range in elevation from 3307 to 3362 meters. Historic records indicate that the first claims in the cirque were located in 1894 (Big Horn County Courthouse, Basin, Wyoming [BCC] 1894:Deed Book [DB] 8976, 8977, 8982, 8983, 8986). The time of abandonment of the district is unclear, but work continued to be conducted at the site at least until 1914 (Kimball 1914). Gold Reef is one of only four known mining areas located in the Wyoming portion of the Absaroka Range. The other areas include the Kirwin, or Wood River, Mining District 12 kilometers to the south, the Stinkingwater District located 26 kilometers to the west and the Sunlight Basin Mining Region located 80 kilometers to the northwest. Several additional mining areas are located in the Montana portion of the Absaroka Range where mineralization seems to have been more pronounced than in Wyoming (USGS 1983).

The project area contains four recorded sites: 48PA253, 48PA2871, 48PA2872, and 48PA2873 (Figure 1.2). Of these sites only the second fails to show evidence of extensive collecting activities. The collecting activities appear to have focused on artifacts considered desirable as antiques including intact bottles and mining

equipment. 48PA253 is the primary site in the cirque consisting of the most highly developed adit, two cabins, a powder magazine, and privy, and is the end-point of the wagon road. 48PA2871 is the lowest site in the cirque, located along Jack Creek near two placer claims. 48PA2872 is a second, smaller adit. 48PA2873 is a collapsed adit and is the only site in the cirque that does not show evidence of extensive collecting activities.



Figure 1.2. Location of sites discussed in text. DEM from Wyoming Spatial Data Clearinghouse (http://wgiac.state.wy.us/html/wsdc_index.asp).

The period of activity at Gold Reef was a time of great uncertainty in mining in the United States (Lakes 1906:250; Smith 1992:157). This uncertainty was the result of changes in U.S. legislation in the 1870s-1890s and the massive over-production and subsequent collapse of the silver industry (Smith 1992:158; White 1991:374). In addition to these specific factors the uncertainty of mineral exploitation in general led to a sophisticated and common pattern of falsification and fraud in the mining industry from its earliest beginnings in California in the 1850s until after the turn of the century (Hoover 1909). Due to the isolated and difficult conditions of the Gold Reef cirque, the amount of energy expended in exploring the deposits of the cirque, and the economic conditions of the time it is possible that the Gold Reef endeavor was an example of one of these fraudulent enterprises. This hypothesis will be addressed using a combination of historical, geological, and archaeological data to determine if the Gold Reef district was a fraud perpetrated on eastern investors.

ENVIRONMENT

Although the ecological components of the Absaroka Mountains were not the draw to the miners at Gold Reef, the discussion of the plants and animals they encountered upon arriving in the area is of value to provide a more complete picture of the conditions they would have lived under. In addition, the ungulates found in the area were probably utilized to some extent as a food source through hunting activities.

Located at approximately 3350 meters in elevation the climate at Gold Reef is typical of high altitude areas in the Wyoming Rocky Mountains (Knight 1994). The more mesic conditions found at these high elevations are a result of several factors including the general cooling, increased precipitation, and lower evaporation rates found with increasing altitude. The increased precipitation is counterbalanced by the increased effective rate of evapotranspiration brought about by the lower atmospheric pressure found at this elevation. Also important in the area are the effects of aspect and soils (Knight 1994:34). The pine forests typical at slightly lower elevations than Gold Reef are mostly restricted to the northern aspects of the slopes. Due to the generally poor soils in the area (coarse due to their derivation from volcanic breccias and conglomerates) the most diverse vegetation communities are located only where there is more effective moisture due to the longer persistence of snowpack. For more environmental conditions the closest detailed study conducted to the project area is the environmental impact statement conducted for the proposed AMAX mining project in the Kirwin area (Hansen and Glover 1973). The temperature range in the upper Wood River drainage vary from a low of -34° C during January to a high of 30° C during July. Annual precipitation rates are approximately 51 centimeters per year with the majority falling during the spring and early summer months. Average relative humidity levels are around 70% at night, but decreasing significantly during the daylight hours (Hansen and Glover 1973).

The Gold Reef cirque lies in the alpine tundra ecological zone, however the mountain forest zone ends approximately 1.5 kilometers distant from the lowest site. A summary of the vegetation located in the site region is provided here followed by major mammal populations. The forest environment is dominated by Lodgepole pine (*Pinus contorta*), Engelmann spruce (*Picea engelmanii*) and Douglas fir (*Psuedotsuga menziesii*). The soils are generally thin and poorly developed and subjected to lengthy drought conditions through the year, limiting the variety of plant species that can survive (Hansen and Glover 1973). The conditions within the Gold Reef cirque are extremely harsh for plant growth. The combination of extreme temperature variations, cryoturbation, common drought conditions, and a short growing season place major constraints upon the ability of most plant species to survive. The most common plant growth in these alpine regions consists of various perennial grasses and sedges. The alpine turf zone contains species of Timberline bluegrass, Trisetum, Alpinesedge, Tufted

phlox, Alpine avens, Alpine forget-me-not, Alpine mountainsorrel, Alpine pusstoes, Alpine sagewort and Dwarf clover (Knight 1994:207).

Large mammals in the area include elk and mule deer, with lesser numbers of moose and bighorn sheep. During the environmental study conducted at Kirwin in the early 1970s, the Thorne Ecological Institute interviewed an elderly local who recounted her father's memories of the area wildlife in the late 19th century. She mentioned that elk, deer and bighorn sheep were quite common and that the gray wolf was common until the 1920s. Apparently the game population reached its lowest point in the 1930s due to over-hunting and has been gradually recovering since that time. During the Kirwin study, a population of approximately 150 elk, 1000+ mule deer, 25-35 moose, and 42-47 bighorn sheep were noted in the upper Wood River drainage. In addition a wide variety of smaller mammals (25) and bird species (48) were noted (Hansen and Glover 1973:7). Of special note in the project area are populations of grizzly bear and Gray wolf that have expanded out of Yellowstone National Park and are found through-out this area of the Absaroka Range. These animals most likely represent a minor source of food (hunting of elk and deer) and/or threat (grizzly bear) to the miners at Gold Reef and their brief discussion here helps to paint a clearer picture of the possible interactions between the miners and their environment.

This introduction has briefly described the environment, location, and archaeology of the Gold Reef district. The following chapters will discuss the geology, history, and archaeology of the area in detail. The technology, methodology, and theory used in the thesis will also be examined. Finally, the disparate sections of the thesis will be discussed and synthesized. This will provide a picture of the archaeology of the Gold

Reef area at the time of its recording in 2003 and an interpretation of human behavior that can be gleaned from the combined archaeological and historic evidence.

CHAPTER 2: METHODOLOGY AND THEORY



Figure 2.1. Survey conditions in Gold Reef cirque.

No archaeological project can be conducted effectively without reference to a body of theory. Although basic field recording and research can be conducted without reference to sophisticated theories of human behavior and human-environment relationships, the simple decisions of transect spacing, et cetera are themselves based on previous theoretical research on the most efficient methods of locating the traces of human culture behaviors on the landscape (Banning 2002; Burger 2002). In light of this fact, it is important to identify the theoretical background utilized in any given project. This chapter will describe the field methodology and theoretical approaches used in the research at Gold Reef. Also, it should be noted that this thesis will utilize English measurements for features and artifacts and metric values will be utilized for natural features. This is the standard in historical archaeology to facilitate the identification of artifacts and features more easily using historical references.

METHODOLOGY

One of the goals of the Greybull River Impact Zone (GRIZ) project was to test the feasibility of non-invasive archaeological methods. Due to this, excavation and testing was not initiated at any of the sites located during the 2003 field season. The 2003 GRIZ project used a variety of survey scales. Three different scales of survey were used depending upon local conditions within the cirque (Todd, et al. 2004).

Although using the smallest possible survey transect is desirable in order to maximize the amount of data recovered, simple practicality dictates the actual spacing used in a project. At Gold Reef the cirque floor was surveyed using a five-meter spacing (Figure 2.1). Based on previous studies of survey spacing (Banning 2002:105; Burger 2002) this was considered to be sufficient to locate the relatively obtrusive historic artifacts and features that were the focus of the Gold Reef survey. Once a concentration of artifacts was located, the area was re-surveyed at a 70 cm interval to delineate activity area boundaries. Finally, in the standing cabin at 48PA253 a single crawl transect was conducted to generate a more detailed picture of the artifact assemblage within the structure. A crawl transect is approximately one meter wide and is conducted on hands and knees to maximize artifact visibility. The crawl transect crossed the length of the cabin in an attempt to identify smaller artifacts that are missed by more conventional

recording methods. This was the finest-grained survey method feasible under field conditions (see Burger 2002).

All members of the 2003 field crew used Garmin Rino 110 GPS units that were used to plot all archaeological materials encountered during the field surveys. The accuracy of the units varied depending upon conditions, but efforts were made to take location shots when mean horizontal accuracy was 5 m or less.



Figure 2.2. Locus GPS system located near 48PA2871.

In addition, an Ashtech Locus GPS system (Figure 2.2) with 5 mm horizontal and 10 mm vertical accuracy (Thales Navigation 2001) was used in an attempt to generate accurate maps of the 48PA253, 48PA2871, and 48PA2873 sites, but due to problems with satellite reception useable data were only collected from 48PA2873. All artifacts located during the site surveys were shot in with the Garmin Rinos and then entered into Excel spreadsheets on PDAs.

Laboratory analysis consisted of analyzing the artifact data entered in the PDA excel sheets. Artifacts of diagnostic value were then identified through the use of historical reference materials, comparative artifacts, and academic texts (Buckles and

Buckles 1980; IMACS 1993; Sagstetter and Sagstetter 1998; Twitty 2001). . Some of the larger pieces of mining equipment were identified through research in the Western History/Genealogy Department of the Denver Public Library through the study of various period mining journals and catalogs. Finally, some information about the mining technology used at the sites was derived from archival research in the county archives of Park, Big Horn, and Fremont counties, Wyoming.

THEORY

Stanley South (2002) noted that there could be no archaeology without pattern recognition. The framework that allows archaeologists to recognize patterns in the record and make inferences about the past is the domain of archaeological theory. Theory determines the questions asked and the answers received during archaeological research. According to Schiffer (1988:462) theory is a set of assumptions and premises that clarify processes or mechanisms that could not otherwise be observed. A number of different theoretical perspectives exist in archaeology, but prehistoric and historic archaeological studies tend to use different bodies of theory. This paper is not strongly theoretical, but is influenced by several different theoretical perspectives.

Unlike hunter and gatherer theory, which is based largely on ecological concepts, the study of complex societies, as typified by historic archaeology, tends to derive its theory from other sources like social history, information theory, and anthropology (Schiffer 1988:464). Although much of prehistoric archaeological theory is based on easily observable natural processes and subsistence strategies, historical archaeology tends to focus more on social and anthropological theories about human behavior. This is possible due to the much larger base of information available in historical archaeological research with the addition of documentary and oral information. Although these theoretical approaches are often not used in mining or industrial archaeology some progress in these areas has been made.

At a basic level, the interest of this thesis in analyzing the activities at Gold Reef in a context with contemporary national and international social and economic activities places this study within the context of world-systems theory. The world-system concept sees the modern capitalist system as distributing different economic tasks unevenly across geographic areas with tasks like resource extraction and manufacturing being located in different regions. This leads to the identification of "core-states" that politically and economically dominate less powerful "periphery" areas from which they derive raw materials (Wallerstein 1974, 1980, 1989). The core and periphery areas are not static and can change over time (like the transition of the United States from a periphery of Europe at the beginning of the 19th century to a core-state by the end of the 19th century). This can be extended to smaller scales (Straussfogel 1997), with the Western United States being a periphery area of the "core" eastern states. The extractive economies of the mountain states are a classic periphery for the industrial portions of the nation further east.

Other useful concepts in the formulation of this study are derived from historical archaeologists that have conducted detailed studies of mining and development in the Western United States and Australia. Donald Hardesty (1998) sees mining communities in the American West as being organized by a series of power relationships between workers and management. However, neither Gold Reef nor Kirwin reached the level of

sophistication where this would have become highly visible in the archaeological record. Pfaffenberger (1998) prefers to see mining in terms of technological activities where the individual artifacts can illustrate more than just the technology utilized at a site, but also the social and cultural phenomena manifested at the locality through a study of *chaînes opératoires*. The concept of *chaînes opératoires* is an attempt to recognize the importance of social choice in the manufacturing process rather than concentrating solely on technological factors (Lemonnier 1986).

Bernard Knapp (1998) identified some common trends seen at mining sites in the United States, Australia and New Zealand. Unlike most archaeological sites, the location of mining communities was determined predominately by geology and mineral deposits with other determining factors such as food and water being of secondary importance. This usually resulted in a community whose economic focus was on a single activity (mining). Also, due to the instability of mining activities and the non-renewable nature of the deposits, these communities were generally highly ephemeral and lasted only short periods before abandonment. Abandonment was driven by the exhaustion of economically exploitable minerals and changes in the world market. This led to a phenomenon termed by Douglas (1998:106) as a "community without a locus" where a population of mining specialists moved from area to area following mineral strikes, while retaining a common and unique set of values and traditions. This transient and expedient facet of 19th and early 20th century mining seems to be a common factor seen in many regions of the world. Good period examples are found in Nevada with the towns of Goldfield where rich deposits were found in 1902 and the mines completely abandoned by 1919 and Hamilton which was founded in 1869 and abandoned in 1871 after an

investment of approximately \$250 million (Hulse 1998). The same pattern seen in the United States is seen in the Australia as shown at the town of Kuridala (originally one of the largest cities in Australia) that entered a decline with lagging gold production and was abandoned with the collapse of copper prices after World War I (Blainey 2003).

One outcome of this economic environment is the substantial lack of variability in material culture observed at mining sites. This is mainly a product of a combination of the temporary nature of the communities and the remote regions in which they were often located. Another reason for the limited variety of goods available was due to the unique household arrangement common to the mining frontier. The household at a typical mining site consisted of a number of unrelated males sharing domestic chores, but otherwise uninvolved in typical household dynamics. This form of household is relatively unique to industrial communities in isolated locales, such as mining, lumber mills, et cetera. Also the cost and difficulty of transportation to most mining localities greatly reduced the variety of goods available. Finally, the majority of any wealth actually produced at a mining locality was exported as dividends to shareholders and owners in other regions, rather than being reinvested in the mining communities themselves. Knapp (1998:6) created a useful list of common characteristics of most mining communities during this period including:

- 1. Physical isolation of the community and a dispersed settlement system.
- 2. The economic predominance of mining activities.
- 3. Exacting, dangerous and periodic work.
- 4. Occupational homogeneity and isolation.
- 5. Communal leisure activities (religious, sporting, drinking) where work remains the chief topic of conversation.
- 6. Sharply segregated family and gender roles
- 7. Economic and political conflict between miners and managers.

8. Multiple and complex communal social relationships: solidarity, shared histories of work and living and an inward focus.

The artifact assemblage at Gold Reef has been shaped by a number of cultural and natural factors. The assemblage at most sites show large, easily replaceable items being deposited as de facto refuse while smaller, more valuable artifacts are retained and curated (Shiffer 1983). At Gold Reef, this tendency is demonstrated by the re-use of the expensive pieces of machinery and structural timbers being moved from location to location within the cirque, and then being abandoned when activities within the cirque ceased. Indeed, for the archaeologist the remote location of Gold Reef is advantageous as most of the larger mining equipment such as the engines, air compressors, and generators remain at the site (Figure 2.3). Large pieces of machinery are generally rare at mining sites in the United States due to the large scale recycling drives run during both World Wars that resulted in the destruction of such equipment at more accessible localities. The Gold Reef machinery is generally in good to fair condition due to the resilient nature of cast iron that forms a significant portion of the equipment located in the cirque (the Coalbrookdale bridge in England is still in use and was constructed of cast iron in 1779) and the environmental conditions found at this high elevation. Also, although the structures were constructed of local pine timbers that are among the least decay resistant forms of wood (Schiffer 1983), the high-altitude environment has led to excellent preservation. The wood at the site has generally reached equilibrium with the environment minimizing decay, but new damage (such as horse cribbing, Figure 2.4, witnessed on site) can expose new surfaces leading to further degradation. Considering their age and the extreme weather conditions found within the circue the artifact assemblage at the sites is generally very good.



Figure 2.3. Gasoline engine lying on the talus slope below the 48PA253 adit.

Although most of the theory discussed in this chapter will not be explicitly mentioned or used in the remainder of this thesis, the overall concern for the complexity of activities within the cirque and getting past the artifacts themselves to understand the decisions and motivations of the population themselves are central concepts in this thesis. Hopefully through the use of the artifacts and features remaining at the Gold Reef locality it will be possible to identify some common aspects of human behavior at these small mining localities.



Figure 2.4. Horse cribbing on cabin 2 at 48PA253.

CHAPTER 3 GEOLOGY

In order to properly understand the actual mineralogical potential of an area like Gold Reef it is important to examine the geology of the area. Such an analysis can determine whether sufficient mineral deposits were present to justify mining work at the location. The Gold Reef area would appear to have potentially valuable deposits at first glance, but as will be discussed below this impression is misleading.

Compared to many regions of the Rocky Mountain range, geologic research in the Absaroka Mountains of northwestern Wyoming and south-central Montana has been relatively minor. The majority of the existing work comes from the eastern portions of Yellowstone National Park, where some of the most westerly portions of the Absaroka Range are found. However, limited geological reconnaissance and mapping have been conducted periodically in the vicinity of the project area since 1899 (Hague 1899, Hague et al.1899). The goals of this chapter are to provide an overview of the geology of the northern Wyoming portion of the Absaroka Range, examine the geologic information available at the time that Gold Reef was in operation, and examine the evidence for significant economic mineral deposits in the region. Although the range extends into southern Montana, this report will cover only the Wyoming portion of the northern Absarokas (for information on the Montana section see USGS Bulletin 1505 [1983]).

OVERVIEW

The Absaroka Mountains trend north-northwest and are essentially an erosional remnant of thick, resistant Tertiary volcanic deposits that are commonly nearly flat-lying or only gently folded, and bear no direct relation to the adjacent or underlying folded mountain ranges (Love 1939). The range is composed of extrusive volcanic breccias and conglomerates of Tertiary age. The volcanics are considered by Wilson (1960) to be the product of mostly non-explosive events originating from a number of vent areas in the Wood River area. This has created the unique topographical setting of the Gold Reef region, consisting of broad, gentle high-elevation flats (3500-3660 meters in elevation dissected by deep, glacially carved valleys. The Absaroka volcanic field is the largest group of Eocene volcanic deposits within the Rocky Mountains. The field covers approximately 22,800 kilometers² encompassing the Absaroka Range, a large proportion of the Gallatin Range and a portion of the Owl Creek Mountains. The deposits exceed 29,000 kilometers³ in volume and are approximately 1500 meters thick (Hughes:1979). By the time the Wiggins formation had been completely deposited the entire Washakie Range was buried to a depth of over 300 meters, the Owl Creek mountains were completely covered, the northern end of the Wind River Range was buried up to the present level of at least 3350 meters, the Big Horn Basin was completely filled and the Big Horn Mountains were buried to at least to the current 2770 meter level (Love 1939). Figure 3.1 shows the locations of the mountain ranges and basins.



Figure 3.1 Map showing the locations of Mountains and Basins mentioned in text. Base map from Wyoming Geographic Information Clearinghouse (http://wgiac.state.wy.us/html/wsdc_index.asp)

The existing deposits probably represent less than ½ of the original extent of the volcanic deposit, and ash-fall from the eruptions was heavy enough to comprise a significant constituent of the Eocene sedimentary rocks found in the Wind River Basin (Hughes 1979). Certain deposits in the Madison and Centennial ranges may also be related to the Absaroka volcanic events. These formations also underlie the Yellowstone Plateau, but are mostly obscured by thick Quaternary volcanic deposits. Within Yellowstone National Park the Absaroka Volcanic Supergroup has been dated to the early and middle Eocene periods (44-29 mya) based on fossilized fauna and flora and radiometric dating methods (Hughes 1979).

Volcanic plugs, breccia pipes and dike systems mark the eruptive centers of the range and Hughes (1979) recognizes a series of highly eroded stratovolcanoes and shield volcanoes composed of flow breccias, lava flows, mudflows, lahars, avalanche debris, and tuffs. The known eruptive/intrusive areas within the Absaroka Supergroup include

(trending from south to north) the Wood River-Kirwin district, the Washakie Needles plug, the Ishawooa Canyon-Stinkingwater, the Birch Hills, the Sylvan Pass Intrusives, the Sunlight Basin Mining District-White Mountain Volcano, Hurricane Mesa-Crandall Basin, Mt. Washburn, the Mt. Holmes stock, the Bunsen Peak stock, the Sepulcher Mountains intrusives, the Electric Peak stock, the Cooke City Mining District, the Haystack stock-Independence mining district, the Emigrant Peak intrusives and the northern Gallatin Range dike swarms (Hughes 1979). Many of the intrusive deposits in this list have been the sites of historic mining operations and exploration as economic minerals are often deposited along the contacts of these plutonic bodies and the country rock.

HISTORIC GEOLOGICAL KNOWLEDGE

One of the aspects of the Gold Reef-Kirwin area that attracted mining interest is the similarity of the geology to that found in the Colorado San Juan Mountains, specifically the Silverton area. The geology of the Silverton District is primarily composed of andesite, latite and rhyolite tuffs, flows, and breccias that were then intruded by stocks of diorite and monzonite during late Tertiary times. Later numerous dikes and vein fissures formed in the area. The area was then re-elevated and deeply cut by fluvial and glacial action during the Pleistocene. The ore deposits in the Silverton area are primarily sulfide ores such as galena, chalcopyrite, pyrite, and sphalerite in a gangue of quartz and calcite (Varnes 1948). Both the basic geology and the ore minerals found at Kirwin were of the same type as those found in the Silverton area. Unfortunately, this similarity was misleading. The intrusive activities and mineralization of the Silverton District were far more advanced than those at Kirwin and Gold Reef. While the Silverton District produced tens of millions of dollars in gold, silver and base metals the Absaroka mining districts never produced significant quantities of mineral wealth.

The only geologic information available to the miners of the Wood River/Gold Reef area were a geological survey conducted by Arnold Hague in 1893 and published in 1899 as the Absaroka Folio by the United States Geological Survey (USGS) and a study of Yellowstone National Park. The map folio/atlas covers the Crandall and Ishawooa 1:125,000 scale Quadrangles that lie immediately to the north of the Gold Reef area (Figure 3.2). This folio remains one of the basic references utilized in all geologic work in the region up through the present day.



Figure 3.2. Location of Hague's study areas in relation to Gold Reef and Kirwin. Basemap from USGS Seamless Data Distribution System (http://seamless.usgs.gov/website/Seamless/)

The USGS published a monograph in 1899 that detailed the geology of

Yellowstone National Park with sections by Arnold Hague and numerous other

geologists. This monograph, along with the Absaroka Folio, was the main source of geologic information utilized by later scientists working in the region. Although the majority of the monograph described geology unrelated to the Absarokas, a section of the report did address the portion of the range that intrudes into the extreme eastern section of the Park and the adjoining Yellowstone Park Forest Reservation. The portion of the range described comprises the Two Ocean Plateau located between Yellowstone Lake on the north and Two Ocean Pass on the south. Hague describes the geology as consisting of welded andesitic and basaltic fragments, which he considered identical to the early basic breccias unit that he mapped in the Absaroka Folio. The formations showed periodic flows of basalt alternating with volcanic breccias with the contacts between the units often showing evidence of extensive weathering.

Hague (1899) described the Absaroka Range as a broad plateau that has been deeply incised by glacial and fluvial action. He noted that Pre-Cambrian rocks do not occur within the range, but do make up a significant portion of the adjacent Owl Creek Mountains. Paleozoic strata were only noted in the nearby Beartooth Mountains in Montana, the canyon of the Clark's Fork and a small locality of Devonian and Carboniferous strata (Madison Formation) up to 300 meters thick in the Sunlight Basin west of Cody. After a period of extended erosion at the end of the Laramide the first Eocene volcanic eruptions started the deposits that would become the Absaroka Range. Hague noted evidence that the eruptions in the Eocene were more or less sporadic with evidence of erosion between layers and occasional inclusions of fossils showing vegetation had started to colonize the surface before being destroyed by a subsequent eruption (Hague 1899).
The following is a brief description of the geologic units identified by Hague (1899). These units would have been used by mining engineers and companies to analyze the deposits within the Gold Reef and Kirwin districts. Although these terms are not used by modern geologists, they do attempt to correlate current designations with them. The deposits exploited at Gold Reef and Kirwin tend to occur in the Late acid and basic breccias.

- Early acid breccias This is the oldest volcanic deposit found in the Absaroka Range. The deposit consists almost entirely of eruptive fragments of agglomerates, sands, silts and tuffs. The deposit is usually light in color ranging from a grayish white to lavender color. The rock consists mainly of hornblende-andesites and hornblende-mica-andesites. Some localities contain fragments of gneiss and schist torn from the country rock during the eruptions. The formation originated from many widespread eruptive centers throughout the Absaroka region.
- Early basic breccias This deposit overlies the relatively small quantity of the early acid breccias, the early basic breccias are of much greater extent with a depth near the eruptive centers of up to 1500 meters. Occasional beds of basalt also occur in this formation. This is the most extensive group of lavas in the sequence, comprising the entire northern region of the Absaroka Mountains. These deposits consist of various clast sizes and are generally dark in color in contrast to the early acid breccias. The rocks are mainly hornblende-pyroxene-andesites, pyroxene-andesites, and basalts with varying amounts of olivine. The strata are mostly comprised of large clasts cemented with volcanic ashes and silts. The color is generally black to brownish gray. Large portions of the deposit exhibit a rough, ropy surface. The eruptive events associated with this deposit seem to have been especially violent and the deposit contains numerous large (1.5-2.0 m diameter) boulders of andesite and basalt with rare occurrences of boulders of twice this size. This deposit comprises the majority of the central Absaroka Range. This is the deposit the bizarre erosional features seen in the Hoodoo Basin of YNP eroded from.
- Early basalt sheets- This deposit is not found in all locations within the range. These deposits comprise numerous individual basaltic flows averaging 1.5 to 15 meters in thickness with a total depth of approximately 300 meters. The flows occasionally show evidence of moderate erosion between events, but generally indicate a more or less continuous series of eruptions. The deposit only rarely shows macroscopic mineral elements.

Some of the best exposures are on Wapititi Ridge and in the canyon of the Shoshone River.

- Late acid breccia This breccia is mostly located in the western portion of the range, occurring largely within the boundaries of YNP where it is only rarely buried by other volcanic materials. In composition the late acid breccias closely resemble the early acid breccias with the addition of minor amounts of augite and hypersthene. The color varies from gray and light brown to purple. The breccia material is angular and small (mostly a few inches in size).
- Late basic breccias These are nearly identical to the early basic breccias, although hornblende is a rare constituent of this deposit. Unlike the ropy texture of the earlier deposit, this deposit consists of far more angular debris that consistently fines from the eruptive centers. This stratum covers much larger areas than the Late acid breccias and where the Late acid breccias are absent sits directly on the basalt sheet deposits. This deposit is best seen on the Trident and Thorofare plateaus where it exceeds 600 meters in thickness.
- Late basalt sheets These flows occur only in limited areas and depths, but there is little compositional difference between the flows. The major difference being rare macroscopic inclusions of quartz in the later flows. These flows constitute the last eruptive phase of the Absaroka Range.

Hague (1899) saw two different phases of intrusive activity in the range with the first being contemporary with the early basaltic flows and the second occurring at the end of the late basic breccias. In the mapped area he designated the earlier phase the Sunlight intrusives and the later the Ishawooa intrusives. The Sunlight intrusives are most notable in the Sunlight Basin with the largest (5 kilometers in length) occurring at the head of Sunlight Creek on the ridge dividing it from the Stinkingwater (Shoshone) River.

This represents the body of geological knowledge that was available to the miners and prospectors in the Kirwin and Gold Reef areas. The following section details the information that is known today, much of which would have become apparent to the workers at the two districts fairly rapidly as they continued their exploration of the area.

MODERN GEOLOGIC KNOWLEDGE

Sporadic geologic investigations since Hague have revealed a much more

complex geological sequence than Hague envisioned (Figure 3.3). Although this information was not available to the inhabitants of the Gold Reef and Kirwin districts, a more accurate understanding of the geology is needed to verify or dismiss the estimated 19th century mineral values.

The only formation of direct interest to this study is the Wiggins Formation as the intrusives of interest to the miners are found within this deposit. The Wiggins formation comprises the highest points of the Absaroka Range and is seldom found below 3170 meters in elevation. The Wiggins formation is usually white or light colored with a texture that consistently fines from northwest to southeast. The materials are mostly conglomerates, with the size of the clasts increasing in the northern portions. The upper portions of the deposit contain the majority of the flows and breccias. The chief

component of the deposit is a biotite-



Figure 3.3. Generalized Geologic Column of Gold Reef Area

hornblended andesite (Wilson 1964). Some localized circular vents were discovered in the area averaging between 60 and 150 meters in diameter. These cones typically contain numerous fragments of fossilized plant materials. It seems likely that the Wiggins continues through to Oligocene times due to the difficulty geologists have experienced differentiating it from the Beaver Divide Oligocene deposits (Wilson 1964). It appears that the Wiggins is nearly identical to the Late Acid breccias and Late Basic breccias of Hague found within Yellowstone National Park (Hague 1899; Wilson 1964). The Wiggins formation is divided into three members (lower, Crosby, and upper). The lower member is approximately 520 meters thick and consists of greenish-gray to grayish-purple to dark gray andesite flows, breccias and interbedded tuffs. The Crosby member is a light greenish-gray color consisting of angular rhyolite fragments combined with andesite porphyry fragments varying between 60 and 150 meters in thickness. The upper member is similar to the lower member in characteristics with evidence of a minor erosional unconformity between it and the Crosby member. These deposits are predominately igneous in nature, but on Mount Sniffel there exists a 15 meter zone of interbedded andesite and limestone breccias (Love 1939; Wilson 1964).

INTRUSIVE DEPOSITS

Intrusive bodies are important in mining as most economic mineral deposits occur along the contacts of intrusive bodies (plutons) and the country rock. The intrusive activities in the Absaroka Range can be divided into two sub-parallel northwest-trending belts running for at least 240 km from the southern Absarokas to the Tobacco Root Mountains of Montana. The belts are approximately 56 km apart in the area converging northward into the Gallatin Range where they are only 24 km apart. These two belts define zones of crustal weakness dating from Laramide to early Tertiary time and serving as outlets for the Absaroka magma chambers. The chemical and mineralogical data suggest that the volcanic/intrusive rocks of the eastern belt are significantly more potassic than the western belt. Although the range as a whole is andesitic in character, the rocks are slightly richer in silica and magnesium, and almost twice as rich in potassium as an "average" andesite. Activity along the belts appears to have migrated from the northwest to the southeast at approximately 2 cm/year. Lead and strontium isotopic studies suggest a derivation from the lower crust or upper mantle (Hughes 1979).

KIRWIN

At Kirwin the andesite and breccia flows of the Wiggins formation (equivalent to Hague's Late acid and late basic breccias) are intruded upon by three different plutonic bodies. These granodiorite and andesite plutons, and associated dike systems define the locations exploration in the Kirwin district. The mineral veins parallel the dikes radiating from the main granodiorite pluton on Brown Mountain (Wilson 1964).

Two types of mineralization are found in the Kirwin area. The first are pyritechalcopyrite-molybdenite-quartz veins located in a highly altered and partly silicified zone on Bald Mountain (Hewett 1912; Wilson 1964). The second is a galena, sphalerite, tetrahedrite, and minor pyrite-chalcopyrite type in a carbonate-quartz gange, commonly including silver that is found more generally throughout the district. Although gold was reported in assays conducted on samples from the dumps and veins of the districts, Wilson (1964) did not note any in his examination of 25 polished sections. The veins of the district cut the flows and breccias of the Wiggins formation and are simple fracturefilled epithermal deposits. The majority of the mineralized veins are clustered around the Brown Mountain granodiorite pluton. Some prospecting was conducted around the Meadow Creek pluton, but the portals to the adits were caved during Hewett's 1912 visits. The veins are narrow, varying from several centimeters to up to 2.5 meters thick. The average width of the veins is between 30 and 60 centimeters. Galena is the principle ore and is always silver bearing in the district. Secondary enrichment is of little importance in the district due to erosion rates exceeding enrichment rates. The order of mineral zoning on Bald Mountain is demonstrated by the veins in the Bryan mine (Hewett 1912). At the upper levels the ore consists of galena, passing into increasing amounts of galena, sphalerite, chalcopyrite and traces of molybdenite, with only pyrite and molybdenite being located in the Illonies vein 396 meters below the upper levels (Hewett 1912; Wilson 1964). As noted above, these deposits are very similar to those found in Silverton, Colorado.

Carefully selected ore samples from some veins reported to run up to 200 ounces of silver a ton, and others 15 ounces of gold. However, these values were definitely exceptional and do not adequately reflect the normal values of the majority of veins in the area (Hewett 1912). A re-evaluation of the mineralogical potential of Kirwin conducted by the Geological Survey of Wyoming in 1964 analyzed twenty one samples from eleven mines throughout the Kirwin District. The highest gold content observed in any sample was 0.25 ounces per ton, with an average content of 0.06 ounces per ton. The highest silver content observed in any sample was 111.8 ounces per ton, with an average content of 14.7 ounces per ton. Excluding the abnormally high silver content of the Little Johnnie sample (111.8 oz.) gives a highest observed value of 41.1 ounces per ton and an average content of 9.9 ounces per ton (Wilson 1964). This demonstrates the presence of

potentially valuable deposits, but most are of low-grade and would not have been economically viable without a rail connection to large smelters.

GOLD REEF

The geology at Gold Reef is similar to that at Kirwin. The intrusive bodies at Gold Reef also penetrate the Wiggins formation, but are a system of dikes and one possible plug of andesite. The altered zones occur along the margins of these dikes in runs of calcified and silicified material. Altered zones are created by the interaction of highly-heated mineral laden waters traveling up the fissure which alters both the intrusive materials and the native wall rock, sometimes leading to the deposition of the valuable minerals (gold, silver, lead, et cetera) along these contacts. The only information available about the actual mineralization within the Gold Reef adits comes from the work of Richard Dunrud (1962) who wrote a Masters Thesis on the geology of the Gold Reef area. During the fieldwork for his thesis he entered and examined the 48PA253 and 48PA2872 adits. In the adit at 48PA253 there are two altered zones at 236 meters and 405 meters from the adit mouth. The adit at 48PA2872 cuts one altered zone 12 meters from its mouth. From the small size of the dump and lack of evidence of altered materials (quartz) the adit at 48PA2873 was likely short and barren. However, the actual length of the adit is unknown due to the caving of the entrance. Neither of the altered zones in the 48PA253 adit are mineralized to any degree. While the altered zone in the 48PA2871 adit contains only minor deposits of pyrite and chalcopyrite of a noncommercial grade.

The Gold Reef and Kirwin areas had all the indications of possible mineral wealth. Like many mining regions in the Western United States localized intrusive bodies have penetrated the country rock of the area creating localized alteration along the contacts. The area is superficially similar to the geology of the extremely valuable Silverton region. It is easy to see why prospectors would have been attracted to the Gold Reef/Kirwin area. Unfortunately, as we have discussed, the similarity was of kind, not degree. Although Kirwin has fair deposits of low-tenor ores with occasional pockets of richer materials, there is no indication that Gold Reef has even low-tenor deposits. The geology sets the stage for the developments discussed in the following chapter on the history of the Gold Reef and Kirwin region.

CHAPTER 4 HISTORY

HISTORICAL BACKGROUND

To properly understand the context of a historic site it is essential to research, as much as is possible, the historical background of events being studied. For the study of Gold Reef this will include a quick sketch of precious metals mining in North America, a discussion of the economic conditions at the turn of the last century, and an analysis of the existing documentation on the Gold Reef and Wood River (Kirwin) mining districts.

The Kirwin district was briefly a bright light on the Wyoming mining scene (Sleepner 1905; Annual Report of the State Geologist [ARSG] 1904, 1909). Because of this there is more information about the Kirwin operations than those at Gold Reef. Due to this the majority of historical data will be derived from the available documentation on Kirwin. The activities at Gold Reef and Kirwin were contemporary and they are separated by only 9.5 kilometers (Figure 4.1). However, the topography of this region is extremely rugged (Figure 4.2) and direct movement between the sites would have been extremely difficult. Both districts were connected by wagon road to Meeteetse at a distance of approximately 48 kilometers with the two roads joining at the confluence of the Wood and Greybull Rivers.



Figure 4.1. Map showing the relationship of Gold Reef and Kirwin. Basemap from Wyoming GeographicInformation Clearinghouse (http://wgiac.state.wy.us/html/wsdc_index.asp).



Figure 4.2. View of the rugged nature of the Gold Reef area.

MINING

Mining has been an important part of human behavior for millennia. The earliest mines were not excavated in pursuit of precious or base metals, but to procure higher qualities of tool stone (Shepherd 1980) and pigment stones (Gregory 2001) than could be found on the surface. The oldest known instance of mining is a hematite "ochre" quarry at Bomvu Ridge in Swaziland that appears to date to over 40,000 BP (Gregory 2001:4) while some of the earliest flint mines are found in the Belgium/Netherlands region dating to around 3100 B.C. with the famous flint mines of Sussex dating to around 2900 B.C. (Shepherd:1980). In the Near East mining for metals, in this case native copper, has

been traced back to at least the 6th millennium B.C. (during the early Predynastic Egyptian period in the Sinai desert) showing that the pursuit of metals is also a truly ancient activity (IAMS website). However, the interests of this paper deal with the historic mining activities brought to the New World by Europeans.

SPANISH MINING

Precious metals mining in North America began with the discovery of the Espíritu Santo Lode near Compostela, Mexico in 1543 (Young 1970:59). During the resulting silver rush from 1543 to 1553 approximately 22 million pesos in silver were produced, totaling more than all the silver seized during the Conquest. The Spanish, and later Mexican, miners largely ignored the northern regions of Mexico that would later become part of the United States. This was due to the continued profitability of the Mexican mines, the distance from existing population centers, and the environmental difficulties found in these outlying areas (Young 1970). The history of North America could have been radically different if the value of the Spanish territories in California, Nevada, Arizona and Colorado had been discovered earlier.

AMERICAN MINING

The first truly "American" precious metal rush (discounting the initial, disappointed impetus toward English colonization of the East Coast) was the California gold rush. When James Marshall found gold in the mill race at John Sutter's sawmill on January 24, 1848 the lure of riches jump-started the processes of western migration that would mark the second half of the 19th century (West 1998:145; White 1991:192). The California

gold fields created innovations in technology, population movements, social relationships, and regulations that would eventually spread and evolve throughout the western mining states. Ex-California miners would often be the first prospectors in new regions using their experience to locate and develop mineral deposits with varying degrees of success. It was one of these returning California miners that made the first major strike in Colorado (Young 1970).

Although a party of Cherokees on their way to California are credited with discovering the first evidence of placer gold in Colorado in 1850, the first major rush to Colorado (the Pikes Peak Rush) occurred in 1858 (Voynick 1992; West 1998; White 1991),. This proved to be a major disappointment and the estimated 100,000 men who had moved to the area dropped to less than 25,000 by early 1859, concentrated in the Cherry Creek area near Denver. A prospector returning to the east from California, John Gregory, located the first Colorado lode deposit on Clear Creek in May of 1859. This led to a second rush to Colorado that spread throughout the state (West 1998:177; Young 1970:147).

As mining districts in one area failed, groups of prospectors would range into virgin territory looking for new strikes, often spurred on by sensational reports by promoters (Triggs 1876). Major mining strikes and flurries of development were experienced by all the mountain states surrounding Wyoming, but mostly leaving Wyoming almost untouched. Colorado remained the largest producer of precious metals in the Western United States well into the early 20th century while major producing districts were located in Montana, Idaho, and the Black Hills. Even Utah, which never became a large producer, had a far more productive mining history than Wyoming.

Aside from the short South Pass rush in the late 1860s, no Wyoming mining district could be considered even marginally profitable.

BIG HORN BASIN MINING

The first recorded visit by a European to the Bighorn Basin was a trapper named George Drouillard who entered the area in 1807. Various fur traders utilized the basin during the remainder of the fur trade period lasting from 1825 to 1840. The first military presence in the basin was a military expedition in early 1860 that recorded the basin as "repelling in all its characteristics" (Wood 1997:36).

The first attempt at organized prospecting activity in the basin was the Big Horn Expedition of 1870 led by Judge William L. Kuykendall. The expedition received national attention during its planning phases, including an attempt by President Grant to prevent the expedition from departing. The expedition was expected to antagonize Sioux tribes in the area as the Bighorn Basin had been awarded to them by a previous treaty. The U.S. Army allowed the expedition to leave Cheyenne on the condition that it would not enter the Bighorn Mountains. However, the expedition ignored their promises to the military and entered the Bighorn Basin and was intercepted shortly thereafter by a small cavalry force near the Greybull River. However, lacking the civil authority to arrest the expedition, the commanding officer was forced to take Kuykendall's assurances that they only intended to prospect the Greybull region and not proceed further to the Bighorn Mountains. No significant gold deposits were located by the expedition in the Basin, and it soon left the Basin to reach the Bozeman Trail in Montana (Wood 1997). Despite vocal claims of the mineral wealth of the Bighorn Basin (Triggs 1876) the fitful

prospecting activities undertaken in the basin in the 1870s and 1880s failed to locate the predicted bonanza.

NINETEENTH CENTURY ECONOMICS

When dealing with mining history and archaeology, economic issues need to be studied closely. National and world economic conditions determine what mineral deposits can be profitably exploited. The economic situation at the end of the 19th century shaped both private and government views on precious metals mining in the American West. The extreme volatility of the American economy during this period led to the rise and fall of mining industries, especially those involving the exploitation of silver (Smith 2000:84). In order to address these issues we will discuss the general history of economic events in the United States, and the primary pieces of legislation that most affected mining.

The second half of the 19th century saw a series of financial panics. These panics are often considered to be the result of a lack of federal regulation of the economy. According to the Gale Group (Thomas (ed) 1999:316) financial panics are "socioeconomic events, often psychologically driven, in which a more or less irrational fear and sense of futility sweeps through investors or some other group." These panics usually followed a period of economic optimism and industrial over-expansion and usually led to an economic depression.

The first of these panics occurred in 1857 as a result of the failure of a number of banks in the northern and western portions of the United States. The South was largely unaffected due to its emphasis on cotton production and the benefits of a protective

cotton tariff. One of the main results of the panic was that the northern and western portions of the nation turned to the Republican Party as an alternative to the Southern controlled Democratic Party and the issues of the economy and slavery were to be major issues during the 1860 election. At the close of the Civil War the southern economy was devastated and the Federal government was plunged deeply into debt. In an effort to stabilize the volatile economic situation Congress created the national banking system in 1863 (Thomas (ed) 1999:773).

The second major financial panic occurred in 1873. In the late 1860s and early 1870s speculators ignored increasing trade deficits and focused almost all investment activities on railroad companies which comprised the majority of Wall Street transactions during this period (Thomas (ed) 1999; Olson and Wladaver-Morgan 1992:154). Many economic historians consider the 1873 panic as the beginning of a twenty year period of economic instability, extending up to the depression of 1893 (Olson and Wladaver-Morgan 1992:154). The increasing trade deficit, combined with a lack of domestic investments, led to 4000 businesses failing in 1872. The panic started in earnest in 1873 with the failure of several major New York banking firms. In the aftermath of these bank closures Wall Street closed for 10 days. By 1875 over 500,000 out of 10 million workers lost their jobs. In 1876 and 1877 an additional 18,000 businesses failed out of a total of 252,000, including most of the nation's railroads and iron mills. Wages also declined during the period, leading to a series of increasingly violent strikes. The economy only began to recover in 1878 (Thomas (ed) 1999; Barabba 1975a, 1975b).

By the 1880s the nation's investors had already forgotten the lessons of the 1873 panic and made investments in railroads, silver mines, industrial plants and foreign

enterprises that far exceeded any possible financial returns. This led to a drop in the price of commodities and the start of a third financial panic in 1883 (Thomas (ed) 1999:773; Olson and Wladaver-Morgan 1992:154). Overproducing wheat farmers and silver miners pushed for a silver standard to combat declining prices. In addition, Eastern industrial growth outpaced gold production leaving insufficient gold in banks to cover accounts. A slight economic recovery in the late 1880s was almost immediately countered by a sudden slump in the British economy in the 1890s. Investment of British capital dropped, and foreign investors sold US securities leading to a Wall Street collapse and a substantial export of gold reserves. In the midst of this crisis President Benjamin Harrison promised to help relieve silver producers from declining silver prices, leading to the passage of the Sherman Silver Purchase Act. The panic accelerated in 1893 when the US gold reserves dropped below the legally set \$100 million minimum level. During the panic, 4000 banks failed, 14,000 (out of 350,000) businesses closed their doors and over 4 million (out of 19 million) workers were unemployed. President Grover Cleveland, in his second (non-consecutive) term, repealed the Sherman Silver Purchase Act to stop the drain on US gold reserves (Hoffman 2002). This led to plummeting silver prices and devastated large portions of the Western economy, which in turn led to violent strikes in 1893 and 1894. Cleveland arranged for eastern bankers (like J.P. Morgan) to purchase special US bonds to replenish the national gold reserves. This, combined with poor European harvests in 1897 led to an influx of foreign gold, helping the wheat farmers of the Midwest. This, along with increasing domestic gold production due to the Klondike rush, ended the depression by 1898 (Barabba 1975a, 1975b). With the rebounding economy mining ventures again started at a low level, and one finds a number of small-

scale mining operations like Gold Reef scattered around the mountains of the Western United States.

GOLD AND SILVER PRICES

Prior to 1873, the real price of silver was higher than that of gold. The silver dollar in the 1860s was worth at least \$1.03 in gold coinage. This higher value of silver relative to gold had led to the silver dollar being a rare component of American coinage from this period as what little coinage was minted tended to be melted down to be resold on the market as bullion. After 1873, world silver prices dropped steadily due to a combination of US overproduction and the steady drop in world demand as increasing numbers of countries switched from silver to gold standards. In 1871, Germany demonetized silver leading to a flood of silver bullion derived from its old coinage which competed with the production of US silver mines. In 1874, the Latin Monetary Union (France, Belgium, Greece, Italy, and Switzerland) also stopped the production of silver coinage. With the 1873 Gold Resumption Act, the US discontinued the traditional 412-½ grain silver dollar and limited the use of existing silver coins to a maximum of \$5 per transaction (Weinstein1967).

From 1867, US silver production increased at a rate of approximately 5 million troy ounces per year, reaching a yearly production of 27,650,400 ounces in 1873. By 1874, the price of silver dropped below the mint's price making sales of silver to the government profitable for the first time in decades; however the mint was no longer purchasing silver bullion (see Table 4.1 for decline of silver prices during the period

·						
Silver Value						
Year	Percent of 1873 value					
1873	100					
1874	98.5					
1875	95.7					
1876	90					
1877	92.7					
1878	89					
1879	86.7					
1880	88.25					
1881	87.5					
1882	87.6					
1883	85.4					
1884	85.7					
1885	82.2					
1886	76.6					
1887	75.5					

1888	72.25
1889	72.18
1890	80.5
1891	76.2
1892	67.25
1893	60.25
1894	48.9
1895	50.5
1896	52.15
1897	46.5
1898	45.6
1899	46.3
1900	47.9
1901	46
1902	44.5

Table 4.1 Changes in Silver Values in the late 19th and early 20th

From Weinstein (1967).

discussed). An effort to soften the economic blow of silver demonetization on domestic silver producers was the production of a new "trade dollar" that was added to the legislation. The trade dollar was of the same weight as the Mexican silver peso, which was highly valued by Asian nations during this period. This was hoped to help American merchants become more competitive in the China trade. However, even with this outlet the steady decline in silver prices led to the value of silver coinage to drop below that of even greenbacks by 1876 (Weinstein1967). Tables 4.3 and 4.4 below show the fluctuating values of gold and silver from the advent of the United States Treasury in 1790 to the year 1920. Notice the stability of gold prices, barring war-time demands, versus the volatility of silver prices after the discovery of the Comstock Lode in Nevada and the effects of the United States Civil War.

SILVER LEGISLATION

During the late 19th century, the US Congress passed several important acts critical to the future of silver in America. These acts all related to whether gold or silver would dominate the country's coinage (Craf 1963; Weinstein 1967; Thomas (ed) 1999:773, 378, 102, 496; Hoffman 2002). The first act officially revoked the coinage of silver, and the following two acts sought not only to restore a bimetallic (gold and silver) coinage, but also to give silver primacy. All three acts sought to provide advantages to specific segments of the population. The first act was the Gold Resumption Act of 1873. This act was passed as a re-valuation of US currency after the Civil War (see Figures 4.3 and 4.4 for silver and gold prices during the period). The act officially revoked the bimetallic standard that had existed since the late 18th century. The act was officially passed due to the lack of silver coins in circulation due to hoarding and the consistent tendency of the mint to undervalue silver leading to coinage being melted down for bullion. The act was also impacted by the influx of gold from the California gold fields that had largely supplanted silver in coinage due to supply (Northrup 2003b:257).

The second act passed was the Bland-Allison Act in 1878. This act required the US Treasury to purchase silver bullion and mint \$2 to \$4 million in silver coins per month. This act was strongly supported by the constituents of senators Richard Bland of Missouri and William Allison of Iowa (Olson and Wladaver-Morgan 1992; Northrup 2003a:28). The constituents of these senators were mainly



Figure 4.3. Fluctuations in gold prices from 1790 to 1920.



Figure 4.4. Fluctuations in silver prices from 1790 to 1920.

farmers that were deep in debt and desired a switch back to a bimetallic standard to increase inflation and make the repayment of their debts easier. The act was (not surprisingly) also backed by Western silver mining interests. This "Free Silver" political movement consisted of farmers and miners who were joined by members of both the People's (Populist) and Democratic parties. In contrast, Eastern businessmen preferred the gold standard as it made US money more competitive with European currencies. President Hayes vetoed the Act fearing drastic inflation with a resumption of bimetallic coinage after the US had switched to a gold standard in 1874. However, the farming and mining interests had sufficient support to overturn the veto and the act was signed into law. In an attempt to minimize the inflationary impact of the return to bimetallic coinage the Treasury began paying gold for greenbacks in January of 1879 and silver coinage production never exceeded the minimum \$2 million per month figure (Thomas (ed) 1999).

Neither the Free Silver movement, nor the gold standard supporters were happy with this compromise piece of legislation and both wished to have the act repealed. The Free Silver coalition was victorious and in 1890 the Bland-Allison Act was repealed and replaced with the Sherman Silver Purchase Act. This act was passed in July of 1890 as a second compromise between Free silver and gold standard factions. It required the government to double its silver purchases and mint a minimum of \$4.5 million of silver per month. The mining groups and western farmers were still not happy with this compromise legislation and felt doubly threatened by the reelection of Grover Cleveland in 1892 that was known to be strongly in favor of a gold standard. The end result of the Sherman Act was the depletion of US Treasury gold reserves leading to the Panic of

1893. In response Cleveland called a special session of Congress and the act was repealed in the fall of 1893. The battle over free silver did not end with the repeal of this act and the issue of Free Silver dominated the 1896 election between McKinley and William Jennings Bryan. Bryan, the "Silverite" candidate, lost the election and this combined with a rebounding economy caused the silver issue to fade out of prominence. The US remained on the gold standard until the Great Depression in 1933 when the Treasury could no longer guarantee payment of debts in gold (Northrup 2003b).

These economic events form the background against which period mining operations need to be examined. We now move into more specific discussion of mining in Wyoming. The following section shows that Wyoming experienced only periodic, and mostly unsuccessful, hard rock mining activities in the 19th century. These activities occurred as early as the 1840s and continued fitfully up until after the turn of the 20th century.

MINING DISTRICTS OF WYOMING

The first major industry in Wyoming was the Wyoming Coal and Mining Company, a division of the Union Pacific Railroad Company, that was formed in 1868 to produce coal for the transcontinental line passing through the state (Smith 1992:46). These coal mining activities preceded ranching and other economic activities in Wyoming by a number of years. The only major precious metal strike in Wyoming was the South Pass Rush of 1867 and 1868. The strike attracted miners from the adjacent states of Colorado and Montana that were experiencing a slump in production at the time. This strike received national attention, but was short-lived. Mining activities at South

Pass had entered a rapid decline by 1869, and most of the district was worked out by 1872. The drop in production at South Pass led to prospecting activities in the Seminole Mountains and the Yellowstone region due to the difficulties Colorado and Montana mines were still experiencing due to refractory ores. At no point did the production of precious metals in Wyoming approach even a significant fraction of that produced in adjoining states (Table 4.2). In 1880, only 12 hard-rock mines were operating in Wyoming (5% of the number in Colorado at the time) with an annual production of \$4000 to \$6000, roughly equivalent to a good day's production in many mines in Colorado and Montana (Smith 1992). However, these ill-fated attempts at developing mining in Wyoming are important to discuss as the Gold Reef and Kirwin districts are members of this illustrious group.

The tendency of miners to follow strikes with little interest or ties to any particular area demonstrates Douglas' (1998) concept of the community without a locus. The ability of American miners to move easily between areas of mineral activity and seamlessly integrate with other miners they had never met is typical of this period. This mining population was able to move easily because they had the same lifestyle, worked in the same difficult conditions, and possessed the same set of technical skills and viewpoints. This highly mobile group originally developed in the mining areas of California in the 1850s and operated with little change until the closing of the frontier mining era in the early 20th century.

The following is a brief description of the known gold mining districts in Wyoming as detailed in Hausel (1980). In this list the Absaroka mining regions are the

Table 4.2. Gold and Silver Production in Wyoming and Adjoining States								
Silver Values in Millions of Dollars								
Year	Colorado	Idaho	Montana	S. Dakota	Wyoming			
1902	12.5	2.4	8.7	0.2185	0.018			
1904	7.2	3.5	6.8	0.1195	0.0001			
1907	8.4	5.98	8.5	0.105	0.0008			
Gold Values in Millions of Dollars								
1902	29.0	2.3	5.0	6.6	0.0			
1904	22.5	1.6	4.4	6.8	0.0036			
1907	27.9	1.0	4.5	6.6	0.0057			

Chart compiled from Engineering and Mining Journal (1903, 1905, 1908).

Kirwin/Wood River, Sunlight and Cooke City districts. In addition to these three

"major" mining districts are the small Gold Reef and Stinkingwater districts.

This list, along with the accompanying map (Figure 4.5) briefly discusses the

location and characteristics of the known Wyoming precious metals mining districts and

localities.

- Centennial Ridge District This district is located near the town of Centennial along Douglas Creek. The district was worked in 1876 and had a combination of placer deposits and sulphide lode ores. Production is unknown, but may have been over \$100,000.
- Cooper Hill District This district was worked in the 1880s and is located on the northern edge of the Medicine Bow Mountains. The area is supposedly rich in gold, lead, copper, and silver ore. Production is unknown.



Figure 4.5. Map showing locations of Wyoming mining districts discussed in text. Basemap from USGS Seamless Data Distribution System (http://seamless.usgs.gov/website/Seamless.

- Dickie Springs- Oregon Gulch District This district is located along the Overland Trail. This area was first worked in 1863, but the original prospectors were killed by Indians and the district was abandoned from 1864 to 1882 when the "Treaty of Five Nations" was signed, reopening the area. The area apparently possesses significant gold placer deposits, but there has been little production due to the widely disseminated nature of the deposits and the lack of a dependable supply of water.
- Douglas Creek District This district is located on the eastern flank of the Snowy Range. Production figures are sparse, but in 1868 when the district was most heavily worked it was estimated to have produced approximately \$220,000 in gold. The area is still explored by amateur gold panning enthusiasts.
- Gold Reef District This small district is the subject of this thesis and is not widely recognized, even among the small mining districts of Wyoming.
- Kirwin (Wood River) District This district was the most developed district in the northern Wyoming Absaroka Mountains. Gold Reef is most closely associated with this district, lying only 9.5 kilometers to the north. The US Bureau of Mines estimates that the district contains reserves of 63,500,000 tons of copper and an equivalent amount of molybdenum.
- Jelm mountain District This district is located southwest of Laramie and was worked in 1872. The deposits are supergene enrichment veins of gold and copper. Production is unknown.

- Seminoe District This district was operated in 1872. The district is located north of Sinclair. Three stamp mills were constructed in the district, but only \$10,000 in copper and gold was recovered. The district was abandoned after 1900. The Sunday Morning Mine was reopened for a short time in 1920.
- Stinkingwater District This district is also in the Absaroka Mountains and consists of ten square miles of the northwest slope of Carter Mountain. The veins consist mainly of disseminated copper and molybdenum.
- Sunlight Region This district is eighty kilometers northwest of Cody. The ores mainly yielded copper, lead and silver with only minor amounts of gold. The only known shipment of ore from the region was 100 tons from the Painter Mine in 1903.
- Sweetwater District The Sweetwater District (South Pass, Atlantic City District) is located at the southeastern tip of the Wind River Range. Emigrants on the Oregon Trail originally discovered gold in this area in 1842. However, real development didn't begin until the first lode deposit was located in 1867. In 1869 the district had a population of about 2000. In 1871 twelve stamp mills had been erected in the district, but by 1872 the workings had largely been abandoned. The district was entirely abandoned by 1875. Some minor work has occurred intermittently in the area, with the most significant being gold dredging operations on Rock Creek from 1933 to 1941. Total production of the district is unknown, but is probably in the region of \$2 to \$5 million.
- The Lost Cabin Mine This is Wyoming's lost gold mine story. All the Western
 mining states seem to have at least one legend of a spectacular lost gold mine, and
 Wyoming's is supposedly located in a park of the Bighorn or Bridger mountains.
 A group of Scandinavian prospectors supposedly worked the placer deposits here
 for approximately a week in 1895 before most of the group was killed by Indians.
 The placer was supposedly so rich that gold nuggets could be easily recovered
 from the surface. The two men who escaped the massacre carried with them 350
 oz. of gold. The two survivors hired 10 other prospectors and went back the next
 spring, but were ambushed and killed before reaching the site.

ABSAROKA MINING REGIONS

Within the wider view of Wyoming mining activities we now focus more

specifically on the mining activities found within the Absaroka Mountains proper. As

previously stated these include the Sunlight Region, Kirwin/Wood River District, and the

Cooke City District straddling the Montana Wyoming border. Little information could

be located on the Stinkingwater District so it will not be discussed here. Gold Reef will be discussed at the end of this section.

SUNLIGHT REGION

Originally called the Telluride Mining Region, the Sunlight Mining Region is located west-northwest of Cody, Wyoming. Prospecting in the Sunlight Region began at roughly the same time as the exploration of Kirwin with the first claim being patented in September of 1890. During the following twenty years 411 claims were filed in the region, with most activity falling in the period of 1903-1908 (Nelson, et al. 1980). Mining activity in the Sunlight District concentrated from the turn of the century to around 1914, with some minor activity continuing until 1951 (Dreier 1967; Pederson 1968). The only recorded production from the region was a 100 ton shipment of gold, silver and copper ore from the Painter property in 1903. Geological assessments conducted by the United States Forest Service in the 1960s located minor amounts of gold and locally significant quantities of silver, copper and lead (Pederson 1968). The copper deposits of the region are the most viable economically. The most common ore mineral in the region is chalcopyrite, with lesser amounts of pyrite, bornite, tetrahedrite, native gold, sphalerite and galena. In the isolated locations where weathering and/or minor supergene enrichment has occurred small deposits of limonite, malachite, covellite, and chalcocite are found. As with Kirwin, and the other mining localities in the northern Absaroka Range, the mineralization occurs as a result of hydrothermal deposition in association with intrusive bodies and small eruptive centers (Nelson, et al. 1980).

The primary work in the district was conducted by the Winona Gold-Copper Mining Co. of Wyoming formed in 1906. The Winona Co. located 31 lode claims from 1901 to 1910. An additional 9 claims were patented in the area in 1920 by the Union Metals Mining Corp. in Lander. The claims cover 175 acres (70.8 hectares) including the Greenhorn, Uncle Frank, Malachite, Copper Queen, Copper King, Mohawk, Copperopolis, Granite Mountain and Butte claims. Most prospecting work seems to have been concentrated on the Greenhorn claim. The 1906 prospectus reported Au-Ag-Cu assays varying between \$28.38 and \$133.94 per ton from this tunnel. At the time of Hausel's 1980 study only one tunnel was not caved, a 315' (96 meter) adit on the Copper King patent. A second group of mines in the Sunlight Basin was the Painter Mine group consisting of five claims located in 1890 (the Silvertip, Boston, New York, Pilgrim and Rainbow claims) covering 103.31 acres (42 hectares). Most of the 100 ton 1903 shipment from the district came from this group (Hausel 1980:55).

As in the Kirwin area, a number of unidentified and un-dated adits are located in the area of the Sunlight district in the Copper Lakes, Copper Creek and Galena Creek Basin areas. One of these was identified as the Morning Star Claim located in 1904 and patented in 1910. The prospect consisted of 331' (101 meters) of adits and drifts (Hausel:1980). These small claims are similar to the Gold Reef district and other isolated prospects located during the GRIZ 2003/GRISLE 2004 field sessions closer to Kirwin. These small operations seem to be quite common on the outskirts of the larger mining districts and are most likely a typical manifestation of precious metals exploration in Wyoming. The main thing that differentiates these small mining activities from the activities at Gold Reef is the amount of effort and capital that was expended.

COOKE CITY DISTRICT

Although mostly located in Montana the Cooke City/New World Mining District was the most developed of the trio of mining areas in this region (including Kirwin and Sunlight Basin). All the workings in this district are located less than three kilometers south of Cooke City, Montana with a few of the claims extending across the border into Wyoming. The area first received attention with rumors of rich ores circulating in 1868. This is the only district of the three that actually invested in reduction facilities with a furnace to roast the ores being constructed in 1875 and a smelter to fully process them following in 1883. However, by 1886 the smelter had been abandoned. At its peak, the district had a population of approximately 2000, rapidly dropping after 1885. However, activity in the district continued intermittently with the McLaren mine producing goldcopper ore from 1940 to 1953. Estimates of the value of ores mined in the district during its life average between \$4 and 5 million dollars. This area has been more strongly affected by uplift and tectonic forces and deeper portions of the deposits have been exposed than in the other regions. Ore minerals in the district consist of galena, sphalerite, pyrargyrite, proustite, chalcopyrite, polybasite, anglesite, cerussite, native silver, freibergite and argentite. These are found in a gangue of quartz, calcite, rhodochrosite, dolomite, ankerite, arsenopyrite, pyrite, marcasite, pyrolusite and various iron oxides. The deposits formed from mesothermal processes in fractures associated with the Cooke City intrusive center located 3 to 5 kilometers north of Cooke City (Nelson, et al. 1980).

KIRWIN (WOOD RIVER) DISTRICT

Ore deposits in the Kirwin area were first discovered in 1892, but major development work did not occur until 1902 due to the recession of the 1890s. For a time, the district was of regional interest (Engineering and Mining Journal 1898, 1904; Knight 1903), but then quietly faded as the potential problems of the district began to manifest themselves (Hewett 1912; Heavy 1936). In 1902 Kirwin reached its highest population (200), and exploratory work in the district reached its highest point in 1904.

Kirwin was originally viewed as one of the most important up and coming mining camps in the United States. In 1905 a reporter for the Big Horn County News stated that he had been questioned about Camp Kirwin in his travels back East and predicted that Kirwin would grow to a town of over several thousand in a few years. He believed that the work accomplished at Kirwin was quite impressive with all the equipment in the district being hauled 120 kilometers by wagon from the rail junction at Cody, and prior to 1901 225 kilometers to the railhead in Montana (Figure 4.6). He described the facilities as including a hydro-plant providing power to the Galena Ridge tunnel, an extensive laboratory and assay office, stores, hotels, residences, and an electrical powerhouse transmitting power to the mines up on the mountain sides. He valued the amount of machinery and boilers in use in the area at approximately \$500,000 (almost \$10 million dollars in 2005) (Sleeper 1905). The Kirwin camp was expected to become a major producer when a projected (but never completed) spur of the Burlington Railroad reached the camp (Geological Survey of Wyo: 1909).

Significant development work at Kirwin began when C.E. Tewksbury became involved in 1897. Tewksbury worked at Kirwin from 1898 to 1907 as the director of the

Wyoming Mining Company, backed by investors from New York. Two other mining companies at Kirwin (the Shoshone Mountain and Mining Company and the Gleaner Ridge Company) were founded by Henry Schnitzel, a respected mining engineer from Lead, South Dakota.

Of these companies, the Gleaner Ridge Company was controlled by the president of the Burlington railroad and mining interests in South Dakota. The Shoshone Mining



Figure 4.6. Map showing probable wagon road route to Gold Reef from nearest railheads. Base map is a 1910 postal map.

Company was controlled by the owners of two steel mills in Chicago. These two companies expended large amounts of capital bringing in machinery and miners from other districts (Heavey 1936). The Kirwin District was already in decline when a devastating snow slide hit in 1907. The snow slide destroyed the home of Tewksbury along with his store and killed three people who had moved in to care for his home during his absence (Bighorn County News 1907). This disaster combined with the failure of the railroad to connect to Kirwin led to the abandonment of the district as an active mining region. However, Tewksbury attempted to continue work at Kirwin until 1914, but was finally forced to close his mining operations. Sporadic attempts to restart mining at Kirwin continued through the depression and into the 1940s, but Kirwin was essentially dead.

A USGS geologist named D.F. Hewett (1912) considered Kirwin to be a classic example of a district where the majority of mining exploration was ill advised, overly enthusiastic and doomed to failure, preventing the district from demonstrating its true potential. Between 12,000 and 15,000 linear feet (3658 to 4570 meters) of tunnels were dug in the district, with 5000 feet (1525 meters) being drifts to determine the extent of veins that had been inadequately explored on the surface. These tunnels were abandoned with little purpose having actually been served. Hewett explored Kirwin in July of 1912 and even at this early date most of the workings were inaccessible due to combinations of flooding, collapsed portals, rock falls, bad air and snow at the higher elevations. He gained the majority of his information from interviews with C.E. Tewksbury whose Wyoming Mining and Milling Company was the only company still operating in the district.

The ore deposits at Kirwin consist of a mix of simple fractures and fracture zones. Hewett (1912) compared these to the deposits in the Silverton district. As at Silverton,

the lavas and flow breccias tend to have a simple fissuring/fracturing pattern with the veins being found in localized depressions in the ridges and often difficult to notice. The walls of the veins are well defined and range from several centimeters to 1.2 meters apart. The economic minerals occur as sulphides along one or both walls. The occurrence of these sulphide minerals vary from 95% in the Pickwick vein to 5% in the Oregon vein. The mineral values at the locality were commonly believed to be mainly in gold. According to Tewksbury selected samples from the veins gave up to 200 oz. of silver per ton and another assay indicated 15 oz. of gold per ton. The only known ore shipment from Kirwin was a carload from the No.2 Bryan tunnel that yielded \$65/ton after transportation and smelting costs.

During his 1912 study Hewett discussed the well-developed mines in the Kirwin District. With the exception of the Tumalum mine, which is a vertical shaft, the mines of Kirwin are all tunnels (adits). The largest prospect in the district was the Galena Ridge tunnel that was 2327 feet (709 meters) long and supplied with air drills and electrically powered ore-hauling equipment. The Bryan vein had three tunnels (1, 2, and 3) which were 80, 480 and 880 feet (24, 146, and 268 meters) long respectively. The lowest tunnel also had 1200 feet (366 meters) of drifts. Four veins were located, two of which were explored before being abandoned. The Pickwick vein was explored by a 610 foot (185 meter) tunnel with a 300 foot (91 meter) drift. Values on the vein mainly derived from silver in pyrite and proustite. The Tumalum vein shaft was filled with water by 1912, but Tewksbury stated it was 250 feet (76 meters) deep with 230 feet (70 meters) of drifts along the vein. The vein contains pyrite with small amounts of galena, sphalerite, chalcopyrite and tetrhedrite with assays as high as \$90/ton in gold. The Molly Logan

tunnel was 1400 feet (427 meters) long and was driven to cut a vein located 600 feet (183 meters) higher on the mountainside, but was abandoned before the vein was located. The Oregon vein had a 340 foot (103 meter) tunnel excavated with vein minerals consisting of sphalerite, galena and pyrite with traces of chalcopyrite. Assays on this vein ran up to 200 oz. of silver per ton. The Long Horn tunnel was currently being excavated by the Wyoming Mining and Milling Co. during Hewett's visit and was 1170 foot (357 meter) long at the time, but had cut no veins. Numerous other tunnels and prospects exist in the region, but were inaccessible due to conditions

The deposits at Kirwin were similar to those found in many mining districts in the West, however the Kirwin area features less intrusive activity and smaller veins than most. The deposits at Kirwin are mostly low-grade and lack the estimated underground reserves to warrant the installation of advanced milling plants to processes the poor ores. The only ores produced by 1912 had all been of medium to high grade, but these deposits did not exist in sufficient quantities to justify further development (Hewett 1912).

Although the initial phase of work at Kirwin proved fruitless a renewed surfaced in 1917 resulting in a preliminary study on the feasibility of restarting work at Kirwin. This work was influenced by the rise in metal prices brought about by the First World War. The Gold Reward Company assayed samples from several of the veins in the district and verified that profitable silver deposits remained in place, but mining activities would need to exploit all the minerals present as the lead, gold, copper and molybdenum in the district would provide a substantial proportion of the value of the deposits (Chapman 1917). However, the rapid end of the war and consequent drop in mineral prices seems to have dissuaded investment. Kirwin was the draw to Gold Reef in many

ways. The following section will show that Gold Reef lacked many of the advantages of Kirwin, yet extensive work continued to be done there after Kirwin was largely abandoned.

MINING AT GOLD REEF

Very little documentary evidence was located regarding the mining activities at Gold Reef. Most of the information on activities in the cirque is derived from the notes of Mineral Survey No. 479 by Russell Kimball (1914) who mapped some of the claims in the district. The survey recorded the locations of the Father Heldman, Golden Crest, Oro Fino, Old Abe, Sugg, Anaconda, and Mammoth Lodes for the Gold Rim (Reef) Mining and Milling Company in 1912. The company was located at 255 W. 60th Street, Chicago, Illinois and William J. Chandler is listed as the secretary. The notes record the adit (48PA253) as averaging 6 to 7 feet (1.8-2.1 meters) high, and 1563 feet (476 meters) in length, with an additional 160 feet (49 meters) of drifts. A single 15'x18' (4.5 x 5.5 meter) room was excavated at the junction with the first drift and showed evidence of formerly being a power plant installation, but the machinery had been removed and was stored at the portal. The claims the tunnel was to service are located 1000 to 1900 feet (300 to 580 meters) higher up on the mountain. According to the surveyor Kimball (1914: 48):

"The tunnel is one whereby, with one system of workings and one plant of machinery, the entire claim can be advantageously and economically developed at great depth below the general surface of the location. The portal is located within 700' of a wagon road which provides transportation facilities between Wiggins Creek, across the divide to Franks Fork, thence to the Grey Bull River and to the town of Meeteetse, Wyoming. The portal, as located, is at the most practical point of entrance to this claim." "NOTE;- With regard to expenditures in the Gold Reef Tunnel; while the estimate of expenditures in this common improvement tunnel has been placed at \$15.00 per lineal foot of tunnel constructed as surveyed October 26, 1912, by this survey, for conservative reasons; from my personal knowledge, (which commences in the year 1900), of the operations in this tunnel, the actual money expended in developing the tunnel as a common improvement has doubtless been much in excess of the herein above estimate. An average expenditure of \$40.00 per lineal foot of constructed tunnel will probably be a
close approximation to the cost of the work connect to by this survey, because, to my knowledge, as late as 1900 to 1903, all material, food supplies, camp and mine equipment used by the claimants or their grantors were transported by wagons from Red Lodge, Montana, the then nearest rail road and supply point, a distance approximating 120 miles by the most direct wagon road. Since 1903 all materials have been hauled by wagon from Cody, Wyoming, by the most direct wagon road approximating in distance 60 miles."

The portal was enclosed in a frame and corrugated iron building 24 ft. by 16 ft.

(7.3 by 4.9 meters) with the long side (south wall) oriented at 70° E. The building

enclosed the equipment serving the adit and served as storage for the disused equipment.

The value of the equipment and work undertaken at the locality is listed in Table 4.3.

These survey notes represent the only meaningful historical data available for the

site. However, they do raise some serious questions. The survey started on October 22,

1912 and was completed on November 4, 1912 with a supplemental survey conducted

between January 14-19, 1914. According to Meeteetse locals access to the locality would

be extremely difficult in October and November, and essentially impossible in January.

Table 4.3. Equipment listed in Kimball's 1912 Survey Notes		
Item	Value (1912)	
1400 feet of 6 inch sheet iron air pipe*	\$150	
1400 feet of insulated copper circuit wiring	\$200	
600 feet of wrought iron air line pipe	\$300	
One air compressor*	\$250	
Two compressed air storage tanks*	\$150	
One steel mine car*	\$75	
Drills and blacksmithing equipment	\$200	
Witte Gas and Gasoline Engine, No. 921 (stored)	\$250	
H.P. and F.M. Roots Co., Rotary Pressure Blower No. 26559*	\$250	
*Items located during 2003 recording		
Total	\$28,820	
Total (2005 dollars)	\$578,700	
At alternate \$40.00 per lineal foot cost	\$71,995	
Alternate Total (2005 dollars)	\$1,445,700	
(2005 value determined via the U.S. Bureau of Labor Statistics inflation calculator (http://data.bls.gov)		

Conducting a proper survey under these conditions would seem to be nearly impossible. Other historic records relating to the site are limited to the original location/claim notices from 1894 and 1897 in the Big Horn and Fremont County archives, and affidavits of work (showing that the legally required amount of work was conducted on the claims) filed by company secretary Knapstein in 1898, 1899, 1901, 1902 and 1903 (BCC 1898: DB 279; BCC 1899: DB 1805; BCC 1902: DB 8740; BCC 1903: DB 11709; Fremont County Courthouse 1901: DB 4970). One further claim of work completed was filed by Secretary H.M. Schafer in 1909.

The work affidavits were compiled from the Big Horn County Courthouse in Basin, and the Fremont County Courthouse in Lander, Wyoming. Other records include the original mining claims filed in Park County, Montana, a mortgage document of the Gold Reef Mining and Milling Company and the State Geological Office mineral survey (No. 479) completed by the U.S. Deputy Mineral Surveyor in 1914. The original claims were made in 1894 and included the Old Abe, Oro Fino, Golden Crest, Mammoth, Anaconda, Golden King, Knapstein, Sugg and Father Heldman lode claims and the Oro Fino and Bonanza placer claims (BCC 1894: DB 8976, 8977, 8982, 8983, 8986). For unknown reasons the Gold Reef Mining and Milling Company was mortgaged to a Peter Marshall of Chicago for \$5000 including claims to all the machinery and tools therein in 1908 (BCC 1908: DB 63). Unfortunately, these records are unable to provide much more information than the dates when work was conducted at the site. Although information about the work at Gold Reef is sparse, sufficient information is available to indicate work continued on site until 1914 (based on the date of the mineral survey). Further, minor information directly relating to the possibility of fraud are presented in the final chapter.

COAL MINING NEAR MEETEETSE

In addition to the precious metals exploration manifested at Kirwin and Gold Reef, the Meeteetse area witnessed significant coal mining activities during the same period. A number of small coal mines were located in the area aimed at supplying local needs. At the time of Fisher's (1906) study the main coal mines in the area were the Conie mine 19 kilometers northwest of Meeteetse, the Orr mine three kilometers northwest of Wise, the Blake #2 mine above Meeteetse on the north bank of the Greybull River, the Woodruff Mine #2 three kilometers north of Meeteetse, the Erskin's mine four kilometers above Meeteetse, and the Dickie Mines #s 1 and 2 on Gooseberry Creek. Additional evidence for the prospecting of coal deposits was noted by Fisher on some beds five kilometers southeast of Meeteetse and at Sunshine Gulch five kilometers northnorthwest of the Sunshine post-office. Fisher states that coal mining had been practiced in the area from at least 1891. One of the oldest mines was the Blake Mine #2 that produced small amounts of coal from 1892 to 1898 when it changed ownership and production was greatly increased. The mine operated until 1902 when it produced 900 tons of coal valued at \$2 per ton. The Orr mine was worked seasonally during the winter with an approximate production of 300-400 tons. The Woodruff mine opened in 1904 and between 1904 and 1906 (the date of the publication) had produced 2200 tons of coal valued at \$2.25/ton. Erskins mine produced 400 tons of coal in the 1905 season. The Dickie mines possessed high quality coal, but had realized little production. Although

Fisher does discuss precious and base metals mining in the Bighorn Basin, he fails to mention either Gold Reef or Kirwin (Fisher 1906). This is odd as the production of these mines seems too high to be consumed solely by local consumption and some portion of the coal must have supplied the boilers at Kirwin.

This chapter represents the extent of the historical and archival information that could be collected on the mining activities within the Wyoming Absaroka Mountains within the restraints of time and funding. Although limited due to the fragmentary nature of the records and the lack of historical research previously conducted in the area, it is sufficient to provide a context with which to analyze the activities at Gold Reef. These data place Gold Reef in context with the other mining activities in the Absaroka Range, demonstrates the economic conditions of its time, and help to develop a picture of the decision processes made by the Gold Reef miners.

CHAPTER 5: THE GOLD REEF MINING DISTRICT

Figure 5.1. Overview of Gold Reef cirque with locations of sites noted. View south-southeast.

INTRODUCTION

As previously mentioned the Gold Reef District consists of four distinct archaeological sites distributed across the cirque at the head of the main fork of Jack Creek (Figures 5.1 and 5.2). These sites include three hard-rock mining localities and one exploration or placer mining camp. The primary site (48PA253) has two cabins and associated features while 48PA2871 and 48PA2873 probably had structures that were then moved to 48PA253. Unfortunately, three of the sites (48PA253, 48PA2871,

Figure 5.2 not included in this version.



48PA2872) show signs of extensive collecting activities. No intact bottles, or other commonly "collectable" artifacts like drill steels, remain on any of these sites.

48PA2873, however, appears relatively untouched by collecting and retains a number of drill steels in addition to a shovel, drifting pick, and miner's spoon. On the attached map (Figure 5.2) the modern trail follows the route of the original wagon road to Gold Reef. The dashed red line indicates the probable route of the wagon road as derived from the 1906 Kirwin Quadrangle and the dotted line is shown as a trail to the tunnel entrance. In addition the 1906 quadrangle shows a structure at the site of 48PA2871 indicating that a cabin did exist on the site and was most likely relocated to 48PA253 sometime after 1906. This chapter will discuss each site in turn. The accompanying Table (5.1) shows the order the sites will be discussed in, their temporary field and Smithsonian Institution numbers and the original functions they served. Also included are two sections of the 1906 Kirwin quadrangle detailing the Gold Reef (Figure 5.3) and Gold Reef-Kirwin (Figure 5.4) areas.

Table 5.1. Site designations and brief descriptions			
Smithsonian Site Number	Temporary Site Number	Use	
48PA253	AU-01	Habitation, Hard-rock	
		Mining	
48PA2871	AU-02	Habitation, Exploration?,	
		Placer Mining?	
48PA2872	AU-03	Hard-rock Mining	
48PA2873	AU-04	Hard-rock Mining,	
		Habitation?	



Figure 5.3. Close-up of 1906 Kirwin quadrangle showing the Gold Reef area.



Figure 5.4. Close-up of 1906 Kirwin quadrangle showing relationship of Gold Reef and Kirwin.

SITES

48PA253



Figure 5.5. 48PA253 Overview showing Cabin 1, Cabin 2, and privy.

This site consists of five features and a dense field of historic trash and abandoned mining equipment. The features consist of one standing cabin, one collapsed cabin, a privy, a powder magazine, and the adit. Each of these features will be discussed in detail below. The two cabins are only separated by a few meters (Figure 5.5), and there is evidence that the intervening area was originally covered with a roof to protect the inhabitants from inclement weather. The privy has collapsed and only a few fragments of the structure are still evident. The powder magazine was partially subterranean and excavated into the hillside directly across an ephemeral drainage from the cabin, the proscribed 300' (91.4 meters) distance from the habitation structures required by Wyoming State mining laws. The adit is located high on the slope to the east of the

cabins in a steep rock face in the middle of a talus slope. It is assumed that a road had been constructed from the cabins to the adit entrance traversing the talus slope as shown on the 1906 Kirwin Quadrangle (Figure 5.3) but all traces of the road have been destroyed with only a partial line of loose posts on the talus showing its probable route. Reaching the adit today is extremely difficult due to the loose talus. In addition to these features a scatter of mining equipment is scattered across the talus slope between the adit and the cabins. This equipment is detailed in appendix 1.

48PA253 CABIN 1

Cabin 1: This is the sole standing structure in the Gold Reef cirque. The cabin is constructed of seven courses of logs in the north and south walls and ten courses in the east and west walls (Figures 5.6, 5.7, 5.8, and 5.9).



Figure 5.6. 48PA253 Cabin 1 interior.



Figure 5.7. 48PA253 Exterior of Cabin 1. View northeast.



Figure 5.8. 48PA253 Exterior of Cabin 1. View southeast.



Figure 5.9. 48PA253 Exterior of Cabin 1. View northwest.



Figure 5.10. 48PA253 Cabin 1 exterior, detail of log notching.

All logs are joined with simple "V" notching (Figure 5.10). Iron strapping was nailed to the logs and into the roof in order to help combat the extremely high winds encountered in the cirque. The strapping on the southwest, northwest and northeast corners are still in place. The piece of strapping from the southeast corner is located on the ground, partially within one of the two modern firepits (Figure 5.11). The logs of the cabin appear to be a mixture of new and re-used logs. Some logs have been roughly squared-off with axes while others are unpeeled. The logs vary from 25-30 cm in diameter. One log in the west wall retains a notch from previous use that was plugged with a roughly shaped triangle of wood (Figure 5.12). The spaces between the logs were originally caulked with wooden wedges, although one area on the north wall also retained a portion of brown and gray plaid that had been stuffed around the wooden caulking. The walls appear to have been covered with tar paper that was in turn covered with a layer of thin wooden lathe. A few wire nails are located in the walls, although the west wall has a cluster of nails, probably used for holding clothing. Nails at a lower level on the west wall may indicate the location of a bunk. The roof has three horizontal logs for supports with the roof proper being constructed of 9 ¹/₂" x ³/₄" planks over 2" x 4" rafters. The door (Figure 5.13) is a board and batten design whose frame is both nailed and pegged to the logs. The door uses simple triangular hinges $8 \frac{1}{2}$ long.



Figure 5.11. 48PA253 Modern firepit consisting of portions of cabins.



Figure 5.12. 48PA253 Partially plugged "V" notch from reused log.

A single crawl transect 5.5 meters in length was located within the cabin (see Table 5.2 for results). Also within the cabin were located an amber bottle finish with large bubbles, a lipping tool applied finish and no visible seam, a spool of solder, two 4-hole mother-of-pearl buttons (1/2" diameter), and two cast-iron stove parts. The exterior measurements of the cabin are 20 feet (6.1 meters) north to south and 17 feet (5.2 meters) east to west. A second modern hearth used to burn parts of the cabin is located in the middle of the cabin and contains numbers of burnt wire nails and pieces of lumber.

Item	Number
Cut nail 6d	1
Wire nail 3d	5
Wire nail 6d	3
Wire nail 8d	2
Wire nail 10d	3
Wire nail 20d	1
Wire nail 30d	2
Wire nail, unidentified	1
Wood shake fragments	30
Metal strap	1
Can fragment, unidentified	1
Safety pin	1
Brass clothing rivet	1

Table 5.2 48PA253 Crawl Transect Inventory



Figure 5.13. 48PA253 Cabin 1 door.

48PA253 CABIN 2

Cabin 2: This cabin is located eight feet (2.5 meters) to the southeast of Cabin 1 and both are orientated along the same axis. Cabin two has suffered a major structural failure (Figures 5.14, 5.15, and 5.16) and is no longer intact like Cabin 1. The roof of this



Figure 5.14. 48PA253 Exterior of Cabin 2. View northeast.



Figure 5.15. 48PA253 Exterior of Cabin 2. View northwest.



Figure 5.16. 48PA253 Exterior of Cabin 2. View southwest.



Figure 5.17. 48PA253 Interior of Cabin 2.

structure has collapsed and structural logs from the wall have fallen and rolled to the base of the slope to the east. The cabin has a plank floor nailed to ½ log supports. The floor



Figure 5.18. 48PA253 Interior of Cabin 2 showing stove.

still has a trapdoor with wooden steps that appears to have entered a collapsed cellar. The remains of a cheap cast-iron stove (Figure 5.18) lie in the northwest corner of the cabin. Two bins lacking shelves lie on their backs in the southwest corner. One collapsed bunk, broken in half, still hangs from the remnants of the ceiling. The stove was a 4-burner wood stove. The top is 27" x 23" and was approximately 23" tall. Near the stove was a single No. 2 ½ sanitary can and one hole-in-cap sardine can.

PRIVY

The privy lies approximately 30 feet (9 meters) to the southwest of Cabin 2. The remains of the privy are highly fragmentary with only a few posts remaining in place



Figure 5.19. 48PA253 Privy overview. View southwest.

(Figure 5.19). A few in place horizontal boards are partially buried in the soil along the northwest portion of the feature. A scatter of fragmentary dimension lumber lies scattered about the shallow depression (Figure 5.20) that marks the edges of the privy pit. Two plain metal hinges remain nailed to the longest, but fallen, support post. No artifacts were noted in direct association with the privy, although there is the potential of buried materials within the pit itself. Discarded artifacts are often found within historic privies, although the thinness of the soil and the hard nature of the bedrock make it unlikely that the privy pit is very deep.



Figure 5.20. 48PA253 Privy plan view.

POWDER MAGAZINE

A semi-subterranean powder magazine was constructed at 48PA253 across a deeply incised intermittent drainage to the southwest of the cabins. The magazine is located the 300 feet (91 meters) from the habitation structures required by Wyoming mining law. The structure has stacked natural rock retaining walls on both sides of the entrance (Figure 5.21). The eastern wall of the structure has collapsed due to pressure from the upslope deposits. This has resulted in several vertical structural posts and most of the east wall lagging collapsing into the structure. The lagging on the west wall is still intact (Figure 5.23). Both of the rear vertical supports remain standing to their original



Figure 5.21. 48PA253 Powder magazine. View south.

height. Although variable the floor of the structure is excavated an average of 45 inches (114 cm) beneath the ground surface. The rear posts rise an additional 30 inches (76 cm) giving an original ceiling height of 75 inches/ 6 ft 3 in (190 cm). The magazine itself is 13 feet (4 meters) by 5 feet (1.5 meters) in dimensions (Figure 5.22). The interior lagging is roughly finished, probably by ax, and is largely deteriorated. Three of the support posts have collapsed into the structure. The posts were braced to resist the down slope pressure, but most have failed (Figure 5.23). The lagging is constructed of half-logs and vary between 6 and 8 inches (15 to 20 cm) in diameter. The interior contains moderate amounts of structural debris, but artifacts were limited to some modern soft drink cans. A portion of the structure's door lies at the bottom of the ravine fronting the magazine Figure 5.25).



Figure 5.22. 48PA253 Powder magazine plan view.

(At this point the ravine is approximately 3 to 4 meters deep. The two roof sections of the magazine are located away from the structure (Figure 5.24) and appear to have been deposited in their current positions by extreme wind-gusts that appear to be frequent in the area.



Figure 5.23. 48PA253 Powder magazine showing intact lagging. View west.



Figure 5.24. 48PA253 Powder magazine roof section.



Figure 5.25. 48PA253 View of Powder magazine showing the remains of its door, the road segment leading to it (in red) and the road segment leading to the talus slope (in blue).

TRASHPILE

A pile of burned historic trash lies four meters to the west of cabin 1. The concentration is three meters in diameter and is eroding into the ravine immediately on its western edge. The concentration contains large amounts of amethyst, clear, and amber bottle glass along with metal fragments and whiteware and crockery fragments. A single badly rusted spoon was also located in this location. The area between the ravine edge and the cabin are covered with large amounts of unidentified equipment and a few segments of track.

ADIT

The main focus of activity at 48PA253 was the adit (Figure 5.26). The adit



Figure 5.26. 48PA253 View of adit from edge of dump.

averages six feet (1.8 meters) in width and seven feet (2.1 meters) in height along its length. Timbering is restricted to the fractured zone immediately within the adit mouth and is limited to three sets of stulls (timber cross-sets) (Figure 5.28). The native rock was sufficiently strong to dispense with additional timbering and cribbing. According to the 1912 survey by Russell (1914) the main adit extends 1563 feet (476 meters) to its head with an additional 160 feet (50 meters) of drifts along altered zones. A single small room 15 ft by 18 ft (4.5 x 5.5 meters) in dimension was excavated at the first of the two drifts in the tunnel. This room appeared to have served as a power plant, but the machinery had



Figure 5.27 Simplified map of 48PA253 Adit.

been dismantled and was stored at the mouth of the adit during his visit. The mouth of the adit was enclosed by a frame and corrugated metal building 24 feet by 16 feet (7.3 by 5 meters). The adit received power from a gasoline engine that ran fans, an air compressor, and a generator by belt power. Lighting in the adit was electric (Figures 5.29, 5.32), although the wiring appears to have been salvaged after work was abandoned. A single mine cart (Figures 5.29, 5.30) remains on the tracks just inside the entrance to the tunnel and a corrugated metal ventilation pipe extends along the left wall of the adit. The entrance to the adit is partially blocked by a semi-permanent snow drift (Figure 5.28)



Figure 5.28. 48PA253 Entrance to adit.



Figure 5.29. 48PA253 Entrance to adit showing mine cart.



Figure 5.30. 48PA253 Mine cart in adit.



Figure 5.31. 48PA253 View of equipment cache inside adit.



Figure 5.32. 48PA253 View out from adit. Note red-painted electrical post.

that was approximately 1 to 1.5 meters in height at the time of recording (7/12/03-7/15/03).

The area surrounding the adit entrance is extremely jumbled (Figure 5.27). The structure originally enclosing the adit mouth is gone with only scattered lumber and sections of corrugated metal remaining. A scatter of charcoal, coal, and slag (Figure 5.39) on the top of the tailing pile indicates the probable location of a blacksmithing area (the base of the anvil is located several hundred meters away near the bottom of the talus slope).

The equipment remaining at the mouth of the adit include a gasoline engine (Figures 5.33, 5.34, and 5.37) a squirrel cage fan (Figures 5.34, 5.38, and 5.40), and a probable air compressor (Figure 5.35). In addition the surface is covered with fragments of unidentified machinery and the remains of standing posts and other structural debris (Figure 5.36, 5.41). A large oven on the south end of the tailings pile has been mostly covered with talus and there is evidence that other machinery completely buried.

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Figure 5.33. 48PA253 View of adit and machinery.



Figure 5.34. 48PA253 View of gasoline engine (rear) and squirrel-cage fan (fore) at adit entrance.



Figure 5.35. 48PA253 Probable air compressor at adit entrance.



Figure 5.36. 48PA253 View from inside adit.



Figure 5.37. 48PA253 View of adit entrance.



Figure 5.38. 48PA253 View of squirrel-cage fan.



Figure 5.39. 48PA253 View of blacksmithing debris.


Figure 5.40. 48PA253 View of adit entrance.



Figure 5.41. 48PA253 View of dump. Note cabins in background.

48PA253 GEOMORPHOLOGY

All the sites within the Gold Reef cirque are geomorphically active in some manner. 48PA253 is the most active of all these localities. A great deal of effort was expended to secure the adit mouth from the active talus field on both sides of the rock outcrop. However, talus creep has already begun to flow into the adit mouth from both the north and south edges. On the south side the talus has already buried a large oven or stove (see Figure 5.42 below). The movements of the talus slope have also buried a great



Figure 5.42. 48PA253 View of talus creep covering large pieces of equipment at adit entrance.

many artifacts on the talus slope, especially a large number of rectangular gasoline cans. One of the major processes affecting this site is debris flows. These occur when sufficient water saturates materials (in this case the talus) to reduce the tension holding them in place. This creates a flow of materials that behave as a liquid, often with the consistency



Figure 5.43. 48PA253 View showing talus slope and associated debris flows. of concrete (Norris 1986; Ritter et al. 2002). At 48PA253 these flows have moved large pieces of equipment from the adit down slope and buried others (see Figures 5.43 and 5.44). The habitation area of 48PA253 is largely unaffected by the large-scale disturbances caused by debris flows. However, it is affected by other geomorphic processes.

The cabins and privy are separated from the powder magazine by a deep ephemeral drainage passing within 5 meters of the cabins and on the east the terrain falls sharply away to a small valley between the cabins and the talus slope. Artifacts have been redeposited from the cabin area into the drainage and valley by a combination of gravity and water actions. Slope wash has moved numerous artifacts down the slope to the east of the cabins and a number of artifacts were located within the drainage passing through the western portion of the site. Active widening of this drainage is evident as the trash pile appears to be slowly impacted by the widening of the channel. During periods of high snowmelt and rain those artifacts that were deposited in the drainage have probably moved further down slope off site. A smaller collection of artifacts were located in the valley to the east of the cabins, but the deep western drainage would have been a more convenient location to deposit refuse. The ground at 48PA253 appears to be fairly stable and does not retain obvious indications of major periglacial processes, though some amount of frost heaving and similar processes must occur at the locality.



Figure 5.44. 48PA253 View from adit showing debris flows (light colored) that have buried historic artifacts.

The artifact assemblage at 48PA253 is actually quite sparse for a habitation site. Particularly conspicuous due to their low count are food cans. This may indicate either a reliance on non-canned food items, the preferential removal of cans due to erosion processes, or the presence of an undiscovered trash dump in the area. The total dominance of wire nails indicates that most construction at this site post dates 1895

(Buckles and Buckles 1980:43). The cans located at the site support this date as well.

Cans	Number	Notes
No 2	1	
6 oz.	1	
8 oz.	2	
9 oz. tall	1	
No 2 1/2	1	
No. 300	3	
No. 303 tall	1	
6 oz. sanitary	1	
		U.S. TABACCO COMPANY
lid	1	USTC
picnic, oyster	4	
unidentified	17	
unidentified with soldered		
seam	2	
sardine	1	
Type 2 condensed milk	1	1885-1903
Keystone beer	1	Modern, aluminum

Table 5.3 Cans at 48PA253. Unless noted all are crimped seamed hole-in-cap.

Table 5.4 Glass and Ceramic artifacts at 48PA253				
Glass and Ceramics	Number	Notes		
Window glass, clear	72			
Bottle glass, Amethyst	48			
Bottle base, Amethyst	1	'A 46'		
Bottle glass, Aqua	12			
Bottle glass, Amber	27			
Bottle glass, Clear	42			
Mason "Ball" jar, clear	1			
Container glass, Cobalt Blue	1			
Whiteware dinnerware fragments	12	Clear, crazed glaze		
Stoneware crockery	27	brown and buff glaze		

Table 5.5 Hardware and Tool related artifacts at 48PA253					
Hardware Related					
Stovepipe fragment	1				
Galvanized sheets	6				
Iron wire fragments	6				
Tarpaper tacks	11				
Wire nails, various sizes	84	See Table 5.6			
Railroad spikes	2				
Iron pipes	2				
Cart rails	2				
steel springs	1				
Segment of chain	1				
Wire, copper	1				
Chrome plated door hinge	1	wave pattern			
Cast iron machinony namo		BABCOCK HDWE, CO.			
nlate	1	5 47)			
Iron bucket fragment	5	517)			
Ax bood	1	boston to boll			
	1				
Cut (square) nail	1	3D			
Starbit drill steel	1	Figure 5.49			
Aluminum? Solder seamed					
can	4	Oil filters?			

Table 5.6 Nails record	ed at 48PA253	
Wire Nails	Number	
3D		6
4D		17
5D		16
6D		2
7D		1
8D		1
9D		3
10D		1
12D		16
16D		6
30D		10
40D		4
50D		1

Table 5.7 Miscellaneous Artifacts at 48PA253					
Miscellaneous	Number	Notes			
Bottle caps	3				
Tent stake	1	"THE BEN BOW CO PAT D APRIL 1 1902 CIN'TI OHIO" "PRESIDENT"			
	4	"PAT.AUG.23.02" "SHIRLEY"			
Clothing buckle	1	(FIG 5.45)			
Unidentified leather fragments	s 6				
Unidentified rubber fragments	5 2				
Shell casings	2	WRA. CO. 23 S&W: Pre 1933 WRA. CO303 SAV: Pre			
Shell casing	1	1933			
Shoe soles	5	with brass/copper screws			
Table spoon	1				
Utensil handle	1	embossed decorations			
Wire pail handle	2				
Horse harness with brass					
buckles	1				
Tar paper fragments	5				
Enameled pot handle	1				
Enameled (graniteware)					
coffee pot	1				
Cast iron stove fragments					
Cast iron stove door	1				
Stove grate	1				
Gladstone Lalande battery	1	Figure 5.48			
Carbon battery core	1				
Pocket watch	1	Figure 5.46			



Figure 5.45. Clothing Buckle.



Figure 5.46. 48PA253 Pocket watch.



Figure 5.47. 48PA253 Nameplate from unidentified machinery.



Figure 5.48 48PA253 Gladstone-Lalande wet battery lid.



Figure 5.49. 48PA253 Star drillbit from pneumatic drill.

48PA2871



Figure 5.50. 48PA2871 Site overview showing location of cabin foundation and hearth. View south-southeast.

48PA2871 appears to be the earliest site within the cirque and consists of a scatter of historic debris on the east bank of Jack Creek at its confluence with an unnamed ephemeral drainage that runs along the west edge of 48PA253 (Figure 5.50, 5.52). The site largely consists of solder-seamed hole in cap cans with lesser amounts of wire and other unidentified metal fragments, scattered clear, amethyst, and aqua bottle glass and leather fragments. Unlike the fully crimped cans common on later sites the use of solder to seal the vertical seam of the can is an older technology that largely fell out of use before 1900 (Buckles and Buckles 1980). The remnants of a rectangular feature twenty feet (6 meters) by 15 feet (4.5 meters), most likely a cabin foundation (Figure 5.51), are located at the southern edge of the site. Also a single historic hearth approximately 6 feet (2 meters) in diameter is eroding into Jack Creek and contains melted historic glass and



Figure 5.51. 48PA2871 View of probable historic foundation. View north. metal fragments. The top of a blasting cap tin (quintuple X) was located near the foundations. The quintuple X blasting caps (Figure 5.53) were most commonly used from 1890 to 1915 (Twitty 2001:10). The majority of other artifacts found at the locality are amethyst and aqua glass fragments with minor amounts of amber glass. Aqua and amethyst glass are generally considered to indicate a pre-1920 date. Other artifacts included the back of a wind-up alarm clock and its key, two boot soles with copper hardware, several lengths of iron wire, an amethyst bottle base (Figure 5.55), an aqua bottle base (Figure 5.54), and several fragmentary aqua glass bottle finishes. Numerous fragments of milled lumber were also scattered about the site. The main artifact type

found at this site were cans. These consisted of a mixture of food and condensed milk types.



Figure 5.52. 48PA2871 Site overview, looking north.



Figure 5.53. 48PA2871 Top of blasting cap tin.



Figure 5.54. 48PA2871 An example of an aqua glass bottle base.



Figure 5.55. 48PA2871 An example of an amethyst glass bottle base.

48PA2872



Figure 5.56. 48PA2872 Site overview. View west.

48PA2872 is an isolated adit located on the east-face of a small spur of rock extending into the cirque from its southern wall (Figure 5.56, 5.61). There is no evidence of supporting structures at this locality, though there is sufficient lumber scattered around the site to indicate that there was likely at least a small structure enclosing the entrance (see Figure 5.58). The tunnel is approximately 7 ft wide (2.1 meters) and 8 ½ ft (2.6 meters) tall (Figure 5.57), but both the mouth and walls of the tunnel are highly irregular. The tunnel extends out of sight at least 100 feet (30 meters) from the tunnel entrance. There is no evidence that rails were ever utilized in this adit. The floor is flat, but covered with loose debris. No timbering is apparent in the tunnel. The dump creates a flat surface extending about15 ft (4.6 meters) outwards from the adit mouth and consists



Figure 5.57. 48PA2872 View of adit interior.



Figure 5.58. 48PA2872 Close up of dump. Snow filled adit entrance visible at top center.



Figure 5.59. 48PA2872 View of adit entrance from inside showing snow and ice drift. of fist-sized rocks. Abundant moss grows on the surface of the dump due to the high moisture content derived from the near-perennial snow bank located inside the adit entrance. Talus is pouring onto the east and west margins of the dump. The dump descends nearly vertically into an ephemeral drainage flowing along its base. Most of the entrance was blocked by a large snow and ice drift (Figure 5.59) and it was barely possible to squeeze in on one side on July 15, 2003. Beyond the drift is a pool of ice 3 meters across. The ice encases at least the bottom two inches of a pair of dynamite boxes and an unknown number of other artifacts are probably located inside it as well.

Unfortunately the artifacts associated with this site are mostly unidentified cans and metal fragments. The total number of cans recorded at the site (10) all occur in the intermittent drainage fronting the tailings pile. All were in a more or less crushed condition precluding accurate measurements. Two deteriorated dynamite boxes (Figure 5.60) are located within the mouth of the adit, but have been heavily gnawed by rodents and the paint has faded to the point that the identification of the company was impossible.



Figure 5.60. 48PA2872 Badly rodent damaged dynamite boxes inside adit entrance.



Figure 5.61. 48PA2872 Plan map.

The cans are moving steadily down slope due to gravity and fluvial processes. Geomorphic processes at this site are essentially the same as those seen at the 48PA253 adit. This smaller talus slope does not lend itself to debris flows, but talus creep is starting cover both edges of the tailings pile.

48PA2873

48PA2873 is in many ways the most interesting site in the cirque due to its largely untouched condition. Unlike the other sites within the cirque which show extensive evidence of collecting activities, the isolated location of the 48PA2873 site along the most westward branch of the Jack Creek channel has apparently concealed the site from collectors. The site drill steels (Figures 5.69,5.70) scattered about and a collection of tools (Figures 5.62, 5.65, 5.66, 5.67, 5.68) located next to a concentration of coal and slag along the edge of the creek. This area appears to have been a blacksmithing area where tools were maintained. A few small linear features may indicate the location of a structure. This seems likely as the features are also the only concentrations of milled wood located at the locality.

The adit (Figures 5.63, 5.64) at the site is excavated into the volcanic breccia and originally had a covered wooden tunnel for the first 10 meters of its length. This tunnel has collapsed and blocked the adit itself. The entrance to the adit has been partially cut into the rock and the tunnel/lagging at the entrance was constructed of strong, roughly finished timbers. There is a significant quantity of galvanized and non-galvanized iron sheeting in the adit entrance indicating the entrance probably had a metal roof over the wooden lagging. The lagging and metal were joined by a number of large metal spikes



Figure 5.62. 48PA2873 Site overview. View southwest.



Figure 5.63. 48PA2873 View of adit.

and bolts. Through the collapsed wooden structure at the entrance it is possible to peer a few meters back into the tunnel where the lagging appears intact. The length of the adit is unknown, but the dump does not appear very large. However, none of the rock on the dump visibly matches any of the rock formations visible at the surface so it must have been driven into virgin deposits outside the oxidized zone. Unfortunately, the area beneath the adit was still covered with a large snow drift at the time of recording (7/11/03) so the actual extent of the dump is unknown. Also, given the density of artifacts located around the adit mouth it is likely that additional artifacts also exist under the snow cover.

ARTIFACTS

The artifacts at the site consist entirely of hardware and tools. No domestic debris was noted at this locality. The artifacts were located in the tool concentration at the northern site boundary, the adit entrance, and several small hand steels along a path between the two. No artifacts were directly associated with the concentration of coal and slag on the edge of the drainage and this may indicate a throw area where the remains from blacksmithing were deposited. If this is the case the actual blacksmithing area was not located.

The tool concentration (Figures 5.62, 5.65, and 5.66) contained:

- 1. One shovel 51 inches (129.5 cm) long with the blade 10 ³/₄ inches (27.31 cm) long and 10 inches (25.4 cm) wide. The blade is riveted to the handle and is marked "CAST STEEL" "HALF SPR...".
- 2. An unidentified iron object shaped like a flattened bell with four bolt holes around the rim and a large bolt through the center. The object is 16 5/8 inches (42.23 cm) in diameter and is 2 ³/₄ inches (6.99 cm) tall.
- One drifting pick. The handle is fragmentary preventing a measurement of length. The head is without markings. Both ends have been flattened by heavy use. The head currently measures 15 ¼ inches (38.74 cm) long and 4 5/16 inches (10.97 cm) high.

- 4. One miner's spoon made of iron. It is 40 ¼ inches (102.24 cm) long. One end is a small scoop and the other ends in a pick.
- 5. One iron hook 5 $\frac{1}{2}$ inches (13.97 cm) long.
- 6. An iron rod with one end beaten square and a length of wire wrapped around the other end.
- 7. Two hand steels, both well worn. Both are approximately 20 ½ inches (52.07 cm) long and 7/8 inches (2.22 cm) thick. They are both octagonal in cross-section.
- 8. One galvanized pipe, three feet (91.44 cm) long and ³/₄ inches (1.9 cm) in diameter. One end is threaded.

Other artifacts located on the site consist of three 30d wire nails, two 20d wire nails, three octagonal hand steels, one octagonal double jack drill steel 53 inches (134.62 cm) long and a graniteware enameled pot (blue-purple exterior and white interior) 9 inches (22.86 cm) in diameter. Two of the hand steels were almost completely buried on the path between the adit and the tool concentration leaving the possibility of further materials being shallowly buried in the area. The artifacts appear to be in their original positions as abandoned by the miners. The only process that seems to have affected the artifact distribution at the area is simple burial. The subtle linear features that could represent a foundation may simply be an instance of patterned ground that commonly occurs in high-altitude tundra areas (Ritter et al. 2002:383) like this one. More artifacts may have migrated into adjoining Jack Creek, but the large snow field covering the area prevented closer examination.



Figure 5.64. 48PA2873 View of adit.



Figure 5.65. 48PA2873 Tool concentration near edge of Jack Creek.



Figure 5.66. 48PA2873 Close up of tool concentration.



Figure 5.67. 48PA2873 Close up of shovel from concentration.



Figure 5.68. 48PA2873 Drifting pick from tool concentration.



Figure 5.69. 48PA2873 Single jack drill steel.



Figure 5.70. 48PA2873 Double jack steel near adit mouth.

This section has described the four sites located in the Gold Reef cirque during the 2003 field season. Of these sites 48PA2872 had only a very small and fragmentary artifact assemblage. The assemblage at 48PA2871 consisted mostly of domestic debris, especially food and condensed milk cans. The technology of the cans at 48PA2871 would indicate an earlier date than the other sites mainly due to the presence of the older soldering technology with few more modern types. 48PA253 is the largest site in the cirque and produced the largest volume of artifacts by far. It is also the only site that retains standing structures. The equipment lying on the talus slope below the adit is discussed in appendix 1, but included patent dates from 1898 until 1908. 48PA2873 is the most intact site in the cirque. Unfortunately, it produced no truly diagnostic artifacts allowing a specific date to be attached to it.

The description of these sites is one of the primary goals of this paper. Regardless of the interpretations and conclusions reached in the final chapter the information in this chapter should serve as a starting point for any further research regarding the Gold Reef mines. Of particular interest for future research will be changes in the condition of 48PA2873. The intact nature of the site is unlikely to survive its discovery by recreationists or the indigenous population of the area.

CHAPTER 6 DISCUSSION

The 2003 GRIZ project was directed toward identifying archaeological assemblages of the upper Greybull River Drainage. As part of this endeavor, a number of graduate student projects were conducted, focused on various research questions addressing prehistoric and historic archaeological resources (Burnett 2005; Derr 2006; Reitze 2004). The Gold Reef study is similar to the studies of the prehistoric sites located within the Greybull project area in that an analysis of the patterns seen within the Gold Reef study area can both provide a better record of historic landuse patterns along the drainage and help define patterns seen in similar sites throughout the Rocky Mountain Region.

As detailed in Chapter 5, the Gold Reef complex includes four sites scattered across the cirque at the head of Jack Creek. Based on artifact attributes, the earliest site in the cirque appears to be 48PA2871 dating approximately to the 1890s, coinciding with the period that the claims were filed. 48PA2876 may be roughly equivalent in age to 48PA2871 and is located near by. The site of 48PA253 is the primary habitation and extraction site located within the cirque. 48PA2872 is an isolated adit with no evidence of nearby structures, but was within easy walking distance of the 48PA253 structures.

Due to some problems with data collection encountered after the end of the field season, the original focus of this thesis (site taphonomy on historic sites) has been replaced with a discussion of the individual sites and placing them in context with the

changing social, mining and economic conditions in the later 19th and early 20th centuries. Similar small mining localities dating to this period are located throughout the Western United States. This analysis will provide a framework to help understand the various forces acting upon these small mining operations. Although the Gold Reef district is, like all districts, unique in many ways, it will still allow us to examine how and why many of these sites developed and disappeared.

Of particular interest when examining the Gold Reef sites is the probability of fraud. Local oral traditions in the Meeteetse area claim that the miners at Gold Reef were involved in fraud deceiving the company and investors back east in Chicago. The bulk of this chapter will analyze the evidence supporting the hypothesis that Gold Reef was indeed an instance of fraudulent activities. It is believed that this is the most likely explanation for a number of discrepancies observed at Gold Reef, but alternate explanations will be briefly explored at the conclusion of the chapter.

GEOLOGY

As previously discussed one of the most important variables in the discussion of any mining site are the facts dictated by the geology of the area. At first glance Gold Reef possessed promising geological conditions with the possibility of extensive precious metals mineralization. The first claims were filed in the Kirwin area a few years prior to the first claims at Gold Reef, but serious development work started at both sites at approximately the same time, in the first years of the 20th century. The Kirwin mines attracted national attention for a short time (Sleeper:1905) and it is some indication of the perceived potential of the Kirwin mines that some of the primary companies were run by respected businessmen from other areas (The Shoshone Mountain and Mining Company was run by Henry Schnitzel, a well respected mining engineer from Lead, South Dakota and two steel mill owners from Chicago; the Galena Ridge Company by the president of the Burlington railroad [Heavey:1936]). Gold Reef seems to have fed off this attention and been run by a Chicago-based company that appears to have had little practical knowledge of mining or hands-on interest in the activities in the district.

The geology at Kirwin and Gold Reef is in many ways typical of that found at mining localities throughout the American West. The presence of one or more intrusive bodies penetrating the country rock and creating mineralization along the contacts is the most common context in which to find precious metals. In addition, as stated earlier, the specific conditions in the Kirwin (and the Gold Reef, Stinkingwater, and Sunlight Basin) region are very similar to those encountered in the area around Silverton, Colorado. Silverton is also an area of Tertiary volcanic deposits that were intruded by various plutonic bodies and then incised by Pleistocene glacial and Holocene fluvial action. This similarity would have made the Kirwin area very attractive to prospectors and investors due to the extremely high value of precious metals extracted from the Silverton area. Between 1860 and 1914 San Juan county (the area immediately around Silverton) produced \$20,438,444 in gold, \$17,208,265 in silver, \$10,489,022 in lead, \$861,967 in zinc and \$5,872,759 in copper for a district total of \$54, 870,457 in minerals (Smith:2000). This translates to over a billion dollars in 2005 dollars when adjusted for inflation. If in these later days of American mining Kirwin could have produced even a fraction of the metals Silverton did it would have been one of the great discoveries of the 1890s.

Unfortunately for the miners and investors at Kirwin, the metals deposits, although present, were of a much lower quality and quantity than those found in the major mining regions of Colorado. The hydrothermal enrichment found at Kirwin, and the rest of the Absaroka mining regions in general, was not nearly as extensive as those found further south. The four known Wyoming Absaroka camps (Kirwin, Gold Reef, Stinkingwater, and Sunlight Basin) never produced appreciable ore during their existence. A few mining districts further north in Montana, produced small amounts of silver and gold, but nothing of particular note. Kirwin itself, and to a lesser extent the Sunlight Basin District, could have become marginally profitable districts producing lowgrade ores if connected by rail to large smelters in other states. However, with the failure of the Burlington railroad to construct the spur to Kirwin it was doomed as a mining enterprise. Mining activities at Kirwin had largely ceased by 1907 with only Mr. Tewksbury continuing periodic work until around 1912. Gold Reef, on the other hand, apparently continued with little change until at least 1912 and possibly later.

The geology at Gold Reef is similar to that at Kirwin, but of less development. The Gold Reef adits are driven along the contacts of the intrusive andesites of the Gold Reef Intrusive Complex and the native rock of the Wiggins Formation. The two altered zones cut by the 48PA253 adit were both barren of economic mineralization. The large scale of the 48PA253 adit driving on into inadequately explored veins was foolhardy, but after cutting the first vein it should have been immediately apparent that the project was a waste of time and money. Crossing the second barren vein 550 feet (168 meters) later should have marked the end of the project, but the primary tunnel continued several hundred additional feet and almost 500 feet (150 meters) of drifts were driven on the two

veins. The 48PA2872 tunnel driven along the contact of a second intrusive body at least encountered some minor mineralization at the one altered zone encountered, but the minor deposits of pyrite and chalcopyrite were not remotely economically viable (Dunrud 1962:58). This could merely be the result of the well-intentioned activities of very inexperienced miners. However, the methods and equipment used at the mine seem to indicate the presence of a number of experienced and reasonably skilled miners. This makes it difficult to attribute the dogged persistence in working the deposits, despite the complete lack of any indication of profitability unlikely to be the result of inexperience.

Finally, we have the discrepancy between the gold values claimed at Gold Reef versus those seen at Kirwin. Newspaper articles (Sleepner 1905) claimed a gold value at Gold Reef averaging about 1.5 to 2 oz per ton of ore. The average found at Kirwin (Wilson 1964) is 0.06 oz per ton. Ore of this tenor would certainly have attracted significant attention, especially among the experienced miners at nearby Kirwin. The fact that Gold Reef is never mentioned as a highly important locality near Kirwin in the historical records seems unlikely if these values were recognized as true.

ECONOMICS

With the decline in silver prices from the late 1870s on, it became increasingly difficult to run a profitable mining operation exploiting silver resources. As the majority of mining localities in the Western United States exploited deposits whose values were largely in silver rather than gold, this led to a shift away from silver mining enterprises and a concentration on gold. Although most regions had varying amounts of gold, mining corporations began to emphasize their gold values when soliciting for backers and

new funding (Lakes 1906:250). The various assays of the deposits at Kirwin indicate that the vast majority of the precious metal value of the veins is in silver, rather than gold, and the major value of the deposits in total is in copper and molybdenum. Combined with the difficulties of transportation, this led to the realization that the mining district was unlikely to be profitable and led to the withdrawal of the majority of the companies and money from the Kirwin enterprise. Whereas published figures for Kirwin included the silver and gold contents of the veins, the only figures given for Gold Reef mention only the gold content (Sleeper 1905). This could indicate an awareness of the marginal status of silver mining by the Gold Reef miners and company and mark a desire to emphasize the far more valuable gold content of the mines.

Another economic motivator for fraud, at least among the miners themselves, were the unusually good wages paid in mining during the period. In the late 19th century a miner working a 12 hour shift made approximately \$3 per day (\$0.25 per hour). With the change to eight and ten hour shifts in the first years of the 20th century this raised the hourly wage to \$0.30 to \$0.38 per hour. Laborers in manufacturing industries did not pass the \$0.25 per hour rate until 1902 and still made less than \$0.38 in 1917. A mucker (the miners shoveling blasted ore into carts) was paid \$0.38 per hour while an agricultural worker doing similar work only made \$0.10 per hour (Brown 1979:102). These were extremely good wages for the period and miners at Gold Reef would not have been able to find jobs with commensurate pay elsewhere when Gold Reef ceased operating.

The number of mining jobs was also in decline during the early 20th century. This can be demonstrated by looking at the number of employed miners during the era. Miners in Wyoming dropped from a peak of 1232 individuals in 1900 to 632 in 1910 and

169 by 1920. During the same period in Colorado, one of the most prolific mining states, dropped from a peak of 22,793 in 1900 to 13,406 in 1910 and to 8208 in 1920 (Brown 1979:12). As a proportion of population miners comprised 10.4% of the population of Colorado in 1900 versus 2.8% in Wyoming and dropping to 2.2% of the working population in Colorado in 1920 versus 0.2% in Wyoming (Brown 1979:13). This shows how important maintaining their jobs would have been to the miners at Gold Reef.

SOCIAL

One of the great tragedies for a large segment of the population of the Western United States at the end of the 19th century was the slow collapse of entrepreneurial mining as the major industry of the area. This left increasing numbers of miners, mining engineers, mechanics, and other specialists without jobs. As the mines closed, the communities of the mountain regions contracted or faded from existence as their populations followed new jobs. The decline of the great mining period of the American West in the 1890s was due to three primary reasons. First, most of the major mining regions had already depleted the richest veins leaving only marginally productive mines in operation. Secondly, the changes in silver legislation chronicled in chapter 4 reduced the profitability of silver production leading to a rapid decline in the silver industry. Finally, the mining enterprises that continued operating tended to be owned and operated by large corporations that concentrated the existing workforce into a few areas. These conditions could easily have caused groups of increasingly marginalized workers to commit fraud in order to continue the life and work to which they had become
accustomed. This becomes more likely due to the prevalence of fraud in mining from its inception.

Fraud was quite common in the mining industry of the American West (Lakes1906; Hoover 1909). This led at least one investor to say "Every now and then I get heartily sick of the mining business... It is a hell of a business and I get sick of sitting here listening to stories, ninety-nine percent of which I am convinced are the bunk." (Smith 2000:xv). The only defense against this "bunk" was the use of respected and honest mining experts to determine the actual worth of a mine. These experts could, hopefully, detect evidence of tampering and provide a realistic assessments of a mine's viability. Mining fraud could take many forms including attempts to influence or predispose the investigator to overvalue the deposits, preparing areas of the mine sampled with pockets of abnormally rich ore, dusting the samples during collection, dusting the samples after collection, dusting the samples during assaying (if done locally), and the problem of crooked assayers running the analysis. The process of dusting is where a small amount of high value material, usually gold dust or chloride of gold, is introduced into a sample. A portion of gold dust smaller than the head of a pin can cause a large increase in the perceived amount of gold in an assayed sample (Lakes 1906:255). Following are a few examples of these various methods of increasing the perceived value of deposits being samples.

Arthur Lakes (1906:250) provided advice to inexperienced investors and mining engineers on some of the tricks used by miners. Attempts to influence an expert would often begin immediately upon entering a new mining camp and an expert or investor should consider the entire town from "the hotel bell boy to the mayor" to be in league

against him and to be as reticent as possible about his purpose in the camp. He also points out that the sale of a mine was often of importance to the entire camp. This led to local newspapers being a particularly untrustworthy source of information on the actual potential of a mine or district. There was also a tendency to try to "salt" the expert, as well as the property, by plying him with alcohol and bribes. Since mining experts were generally poorly paid the bribes could be very hard to resist.

On the site, the expert had to ignore the advice of the mining foreman who would often point out the "best" places to collect samples. Methods of salting mines included drilling holes, filling them with choice ore and then disguising them, or in soft, fractured rock discharging a shotgun loaded with gold dust into the face. Once the samples were taken, the expert should not let them out of his sight in order to prevent tampering. He was also advised to collect small samples and hide them on his person to double-check the samples in the lab if they showed an unexpected gold value. An expert was also often at a disadvantage because he was dependent on the miners to do the blasting or digging, giving them ample opportunity to dust the resulting samples (Lakes 1906).

Sometimes the miners would actually salt the workings without the knowledge of the owner or supervisors. Lakes (1906) gives an example of a mine that was condemned by an expert, who was then requested to re-examine the mine because recent assays had shown much better gold values. On returning to the mine, the expert noticed obvious signs of salting and had the samples tested proving them to be chloride of gold (which doesn't occur naturally). The owner was upset because he had been led to invest more capital in the mine based on these erroneous findings.

Even collected samples were in danger of tampering. Experts were warned to go so far as to sleep with the samples under their pillow and not to let the samples out of their sight during the day. Miners would sometimes stick a syringe with some gold dust through the bag, or make copies of the wax seals so they could open and close the bags unnoticed. If the samples were assayed locally, "innocent" miners would sometimes come in to observe the process and "accidentally" spill ashes from their pipe into the batch. This would usually contain a small amount of gold dust. A story of a crooked assayer says that he was found to keep particles of gold dust under his fingernails and used this to alter the gold content of batches. Lakes (1906:257) does state that "it often happens that a miner who in every other relation of life is as honest as the day, draws a line, when it comes to selling a mine to what he considers "fair game""

Attempts at fraud were often helped by rumors and circumstances that lent an attractive aura to an area. In the Kirwin/Gold Reef area, the similarity of the area to the Colorado San Juan's, particularly the area around Silverton increased interest in the area (Hewett 1912). This goes a long way toward explaining much of the early interest in the region. The great excitement at Kirwin, as mentioned earlier, also served as an impetuous toward drawing investor's attention to the Absaroka mining districts. The continued tantalizing possibility of a rail link to the Kirwin mines kept hopes high, especially when a vice president, general manager, and the chief engineer of the Chicago Burlington and Quincy railroad visited Kirwin and a crew from the Chicago Northwestern railroad surveyed a route to Kirwin in 1905 (Woods 1997:235).

Coinciding with all this action at Kirwin the *Wyoming Standard* ran a story in 1905 stating that the veins of Gold Reef were of good size, easily accessible by wagon road with assays averaging from \$18 to \$26 of gold per ton (The Wyoming Standard (WS), 12 August, 1905). This contrasts markedly with information about the site from other sources. The wagon road only connects the cabin near adit 1 and does not access the claims themselves (USGS 1906). This also contradicts the findings of Richard Dunrud (1962) who found no evidence of mineralization in the two veins located within adit 1. With the government controlled price of gold at \$20.67 per ounce (Gold Information Network: 2001) this is significantly higher than any gold contents reported at Kirwin (1.8 ounces/ton vs. 0.25 ounces/ton at the Bryan mine [WS 1905; Wilson 1964]). Also suspicious is the total lack of crucibles or other assaying remains at any of the sites in the Gold Reef cirque. 48PA253 was sufficiently developed that it is extremely surprising not to find any remnants of these activities due to their common use in most mines to test values when driving adits and shafts to intercept mineral veins.

THE 1914 MINERAL SURVEY REPORT

The primary record of activity at Gold Reef (the mineral survey) also demonstrates some disturbing discrepancies. The mineral survey report follows standard established guidelines (ITC: 1900), with one exception. Mineral survey reports conducted by the General Land Office were required to contain pages with the sworn testimony of the surveyor and his assistants. These testimonials are absent in the report (Kimball 1913). In addition, the survey was supposedly conducted in October and November of 1912, with a revisit in January of 1914. Local residents today consider the Gold Reef area to be inaccessible between mid-September to early July. During the initial reconnaissance of the site in the first week of July 2003 abundant snow-drifts still existed on the northern aspects in the cirque and completely covered the entrance to adit-2. This was despite the fact that the preceding winter was one of abnormally low snowfall due to drought conditions in Wyoming. Conducting a detailed legal survey during the late months of the year seems highly unlikely, especially since most of the claims mapped exist at altitudes of around 3658 meters Finally, the entire cirque was surveyed at 5 meter spacing with the relocation of witness corners one of its primary purposes. The only witness corner located is immediately adjacent to the cabin. None of the others were discovered despite the fact they were described as permanent engraved stone markers. These anomalies are not the only indications of unusual activities at Gold Reef.

ORAL TRADITION

The local population in Meeteetse still tells stories about the miners at Gold Reef. The majority of these stories imply that the mine was a fraud. One story states that one of the investors from back East kept hearing glowing reports to the effect of "Going great, going to make a big strike anytime now!", but when he went to visit the site he found it abandoned and no one working on it (Lawrence Todd, personal communication 2003). A final amusing story was a story of two Chicago saloon keepers who had purchased the mine without first seeing it. They traveled to Meeteetse and hired a guide to take them up to the mine. As they continued climbing up the mountains on a warm summer day they began to realize how out of shape they were. Finally they asked the guide to stop for a minute. They looked each other in the eye and the first asked his partner "Do you know anything about mining?" and the other replied "No, I thought you

did!" They immediately turned around and returned to Chicago without ever seeing the mine (Carol Hunter Meeteetse Museum, personal communication 2003).

ATTEMPT TO SAVE JOBS?

The very real possibility of fraud being perpetrated by the individual miners without the knowledge of the higher company management could be one of the reflections of the various interplays and power struggles often seen between workers and management. The attempt by workers to fool the management to maintain work and employment in marginal or totally unprofitable operations is not unheard of. As mentioned previously (Lakes 1906), professional assayers of his acquaintance encountered instances of workers falsifying the actual mineral wealth of a mine in order to protect their employment. With the high wages earned in mining, especially with little oversight by the company management as at Gold Reef, the temptation to commit fraud would have been quite strong.

The competition for fewer and fewer mining conditions became increasingly prevalent during the early 20th century (Aiken 2005; Peterson 1971). For miners in the late 19th and early 20th centuries, their specific sets of skills were not likely to gain them well-paying jobs anywhere except the mining industry. The general decline in the number of jobs in mining threatened the way of life practiced by many individuals in the Western United States. These individuals shared a common set of values and traditions that would have contributed to their willingness to cooperate in maintaining work through questionable means. The prevalence of ill-advised mining activities seen in the late 19th and early 20th centuries may reflect the desperation of these. At Gold Reef, at least, it

seems there was a group of skilled and knowledgeable workers who continued to pursue mining activities on a site with little to no actual potential. At the same time, false information seems to have been transmitted both to the company management and the public at large. It is difficult to see this as anything except an instance of fraud. Even from the very beginning the amount of gold in the deposits was greatly exaggerated, the proposed work was ambitious to the point of replicating one of the great (and ultimately unsuccessful) mining engineering projects in US history, and work continued here seven years after work had been abandoned at Kirwin which possessed actual mineral deposits and a more accessible location.

FRAUD?

It is difficult, if not impossible, to make concrete determinations of the motivations of humans in the past. It is also difficult to determine their exact decisions and actions. However, the evidence collected at the Gold Reef sites allow us to reach defensible conclusions about their activities. The Gold Reef sites are representative of a large number of small mining operations throughout the western United States at the end of the 19th and beginning of the 20th centuries. The difference between Gold Reef and most of these small exploratory operations is the fact that they did not cease work when the unprofitability of the deposits became evident. It seems clear that the miners on the ground sought to preserve their jobs through misleading the company management and were assisted in this by the local population.

This is hardly surprising considering the difficult economic conditions faced by the mining industry during this period and the desire of the local community to attract

outside investment to ensure their economic viability. The mining operations at Gold Reef and Kirwin were used by promoters to try to win the attention of a major railroad company. Having a rail connection during this period often meant the difference between economic prosperity and failure. This made the success of Kirwin, and the other mining operations in the area, important to the entire area. With the failure of the CB&Q to build a line to Kirwin, the mining operations in the area were doomed to failure due to the low tenor of their ores. Activities in the Kirwin area came to rapid end at this point.

Despite the failure of the well-financed, and well-recognized Kirwin operations work at Gold Reef continued for at least seven more years. And while the Kirwin mines were recognized as having significant, if low-grade, ores available, Gold Reef never produced any indication of valuable ores other than in highly exaggerated claims in newspapers. The adits themselves showed only the most minor and unprofitable amounts of copper mineralization and would have been recognized as such by anyone in the mining industry. This combined with instances such as the visit by an investor who found no one working at the locality, indicate something seriously wrong with the work conducted at Gold Reef. When the available information is combined we can have little doubt that Gold Reef is an example of fraud. The fraud was not the high-profile fraud that bilked investors out of millions of dollars that are commonly found in history books, but a smaller scale fraud perpetrated by a small group of workers trying to maintain their jobs at the expense of a small group of investors back East.

Determining fraud, as is probably the case at Gold Reef, would be very difficult to determine from a strictly survey/recording viewpoint. It is necessary to conduct as much archival research on the locality as possible. Good locations to start such research are the

records at the Bureau of Land Management who retain records of all mining claims within their jurisdictions. Once the claims have been identified further information can be gathered from the local county archives as mining operations were required to submit sworn affidavits verifying the required money and effort was expended at the location during every year. Finally, local period newspapers may contain references to the location. If it is a major locality it may also be mentioned in regional or national mining or geology publications. Unfortunately, the actual records of individual mining companies were rarely preserved and are extremely rare even for large, well-financed operations.

ALTERNATE EXPLATIONS

Although fraud seems a logical explanation for the unusual actions at Gold Reef, there are other possible explanations. The two discussed here are the shift occurring during the 1890s and early 20th century from smaller entrepreneurial miners to mining by large corporations and the human tendency to hold out hope that diligent effort will uncover riches if pursued long enough.

One of the major changes on the mining scene at the turn of the last century was the shift to corporate control of Western mining. It became increasingly difficult for individuals and small companies to accumulate the capital to create a successful mining enterprise. This led to the consolidation of existing companies into large conglomerates. This was the "Trust era" of American history with the formation of giants like John D. Rockefeller's Standard Oil Company and J.P. Morgan's United States Steel Corporation (Malone 1981). Similar consortiums formed in mining, especially the copper industry. The formation of the Amalgamated Copper Company in Butte Montana is a good

example of this shift. Amalgamated Copper formed when members of Standard Oil recognized the profits to be made controlling a large portion of the world's copper production. With electricity becoming more widely available demand for copper was growing rapidly and the Butte mines were some of the largest in the country. The local mining companies of Anaconda Copper Mining Company, the Washoe Copper Company, the Parrot Silver and Copper Company and the Colorado Smelting and Mining Company were some of the original components of Amalgamated and between them controlled the majority of Butte's production (Malone 1981:138). Butte (and the state of Montana) managed to fight the power and control of these large interests for a time, but by 1900 with the last of the Montana entrepreneurial mine owners Marcus Daly was seen to mark the passing of the old captains of frontier mining and industry and the ascendance of the large, impersonal new corporations (Malone 1981:157).

The persistence and large scale of work at Gold Reef could have been an attempt to attract the interest of one of these new mining corporations. Selling your claims or mines to these corporations was one of the few remaining ways to make a significant profit off a small mining operation. The investment in advanced equipment and their proximity to Kirwin (which did have the attention of established figures in the mining industry) may have been part of a plan to attract the interest of one of these companies and sell-out. Although we will probably never know, the site may have been visited by representatives of these companies. However, the lack of any significant mineral potential would have been immediately clear to any competent inspector. Even if the deposits at Gold Reef had been valuable, the amount likely to be recovered from the location would not have justified the expenditure of significant funds by a corporation.

Finally, it is possible that the continued operations at Gold Reef may have been the result of extreme optimism. Many small miners honestly believe that their claims have significant value, regardless of what an objective analysis of the deposit might indicate. Individuals will sometimes work a claim always believing that wealth lies just beyond the next stroke of the pick. A family friend maintained a gold claim in Colorado for over thirty years hoping that gold prices would eventually rise enough for him to make money from it, but never did. This doesn't seem particularly likely at Gold Reef as the amount of equipment and labor used here would have been highly expensive and difficult for a small group to maintain and fund.

FUTURE RESEARCH

There is still work that can be completed at Gold Reef and on these issues. An interesting study would be research on similar sites to try and determine just how prevalent the patterns seen at Gold Reef are. The districts at the Stinkingwater and the Sunlight Basin districts would allow for an analysis of late 19th and early 20th century mining in the Absaroka Mountains, and these studies could be expanded to small sites in adjoining states. Also, the extremely active geomorphology of the Gold Reef cirque would allow the study of alpine processes and their effects on archaeological sites of a known age.

Historical archaeology in general, and mining archaeology specifically, is often ignored or dismissed by archaeological surveys and organizations. The criteria for recording historic resources create a tendency to dismiss many small sites as being unimportant and not worth recording. Every adit, cabin and even every prospect pit

represents a manifestation of human behavior every bit as important as any prehistoric artifact or feature. The common tendency to ignore these small mining features leaves a large gap in our understanding of the human use of the landscape. Understanding Euro-American land-use patterns is as important as analyzing prehistoric land-use patterns, especially considering the much larger impact our activities have had on the environment. Hopefully further studies like this one will be conducted as mining in the Western United States forms a very important portion of our heritage and interest in these sites is widespread. Part of our duty as archaeologists is to make the past relevant to the public as they generally pay for our research through taxes or added costs on construction projects. Since large portions of the public have an interest in the American "frontier" and mining sites the lack of attention paid to these resources by the professional establishment is inexcusable.

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