

Gold Geology: Shaping Mining Communities
Laura Dunn

It will start with a “Once upon a time” and a grand dream. I do not know how it will end. We are living the ending. Or at least we are living near the people who are living the ending. They live in California. The whole thing reminds me of merging on the expressway. Let’s say there are two cars, a blue car and a yellow car. Each is driving from very different places with very different pasts. It is chance that causes them to get into a minor fender bender (Blue collides with Yellow while merging). Fear not, no one is seriously injured; but inevitably, there will be lawsuits and insurance questions. And the daughter in Blue has taken a fancy to the son in Yellow. As the cliché goes, “Two worlds colliding.” Or, according to the Spice Girls, “Today is the day when two become one.” Things are like that in California. Kind of.

* Part I: Gold (The Yellow Car) *

“Once upon a time” happened a long time ago. A very long time ago. Millions of years. After all, this is the story of the “yellow car”. This is the geological history of California gold.

Begin with a mantle – a plastic like solid material. Place a rigid crust atop. Break the crust into several plates with elaborate names such a North American or Farallon. Allow forces within the mantle to move the plates into a super land mass. A fancy cooking recipe? Geological history. By 270 m.y. ago, all the continental plates had assembled into the giant land mass called Pangea. 65 million years later, Africa and South America began pulling apart from Pangea, and the rifting triggered western movement of the North American continent. In fact, North America began moving so quickly that it rode over the adjacent sea floor creating friction and heat. The heat caused partial melting of the crust, and rocks melted to form magma. This magma erupted in a series of volcanoes that formed the Sierran Arc (Regional). Millions of years of erosion would wear away at the Sierran arc, exposing the hardened, unerupted magma (granite) that comprises the current Sierra Nevadas.

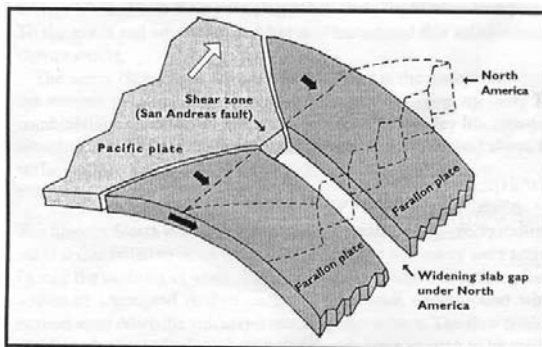
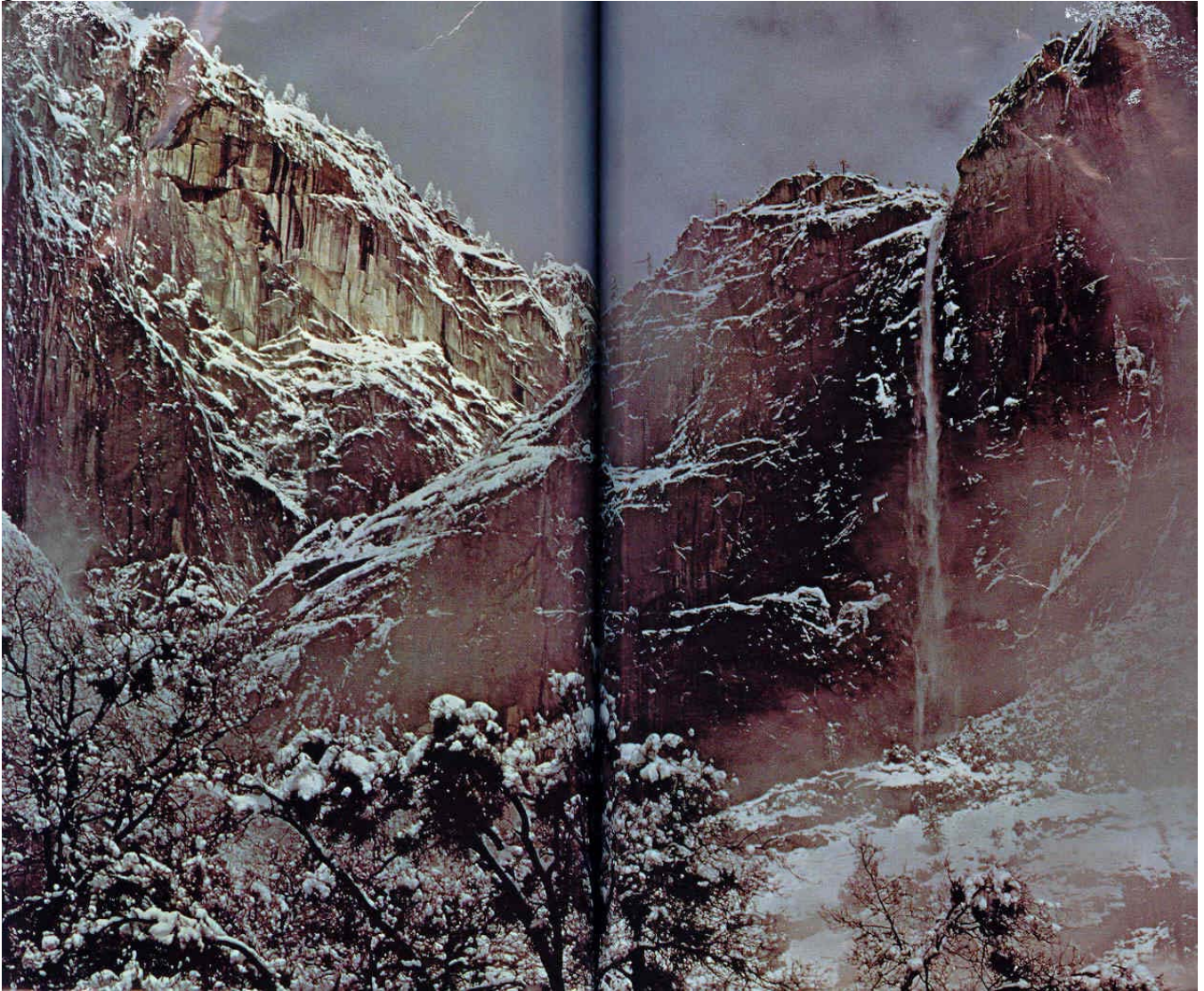


Figure 2.6: Slab gap beneath North America.

The Farallon plate crashed into the North American plate and subducted, exposing the Earth's crust directly to the upper layer of the mantle.

Next, crash the Farallon plate (recently separated from the Pacific Plate) into North America and subduct it into the mantle (about 20 m.y. ago). Allow the Pacific Plate to shear into North America, creating the San Andreas Fault. Good, now you have successfully created a “slap-gap affect” exposing the crust of North America directly to the mantle, making it pliable and paving the way for a stretching/thinning affect (Regional). Good, now you have also successfully created the Basin and Range with the westernmost mountain change being the Sierra Nevadas. But where is the

gold?



The Beautiful Sierra Nevadas were formed as a result of plate tectonics and weathering.

As 49ers would certainly proclaim, the gold is found at the base of the Sierra Nevadas. And as Mary Hill, author of *Geology of the Sierra Nevada* deduced, it was the same forces that created the Sierran Arc that created the gold. “During this mountain making period ... the way was prepared for gold ore to form, for then the Mother Lode fault system and many of the numerous related faults were born ... Cardinal to the making of mountains, the faults opened avenues along which mineralizing solutions could rise into the depths” (Hill, 1975). Not only were the rocks from the Paleozoic and Mesozoic periods transformed into metamorphic rock, the cooling magma cracked, creating faults. Hill further explains, “...it was during the cooling of the granite magma that hot waters and gases steamed upward penetrating the rock through joints and fractures, leaving behind the telltale evidence of their passage. Nowhere was the

evidence more apparent than near the fault breaks, where the mineralizing solutions left veins and “vugs” filled with ore-bearing minerals.”

The United States Geological Survey explores the origin of “Lode” (primary) deposits further, offering three hypotheses for the presence of gold. First, in areas exposed to volcanic activity, circulating groundwater “excited” by the heat seeps 2-5 miles within the surface and dissolve metals from surrounding rocks. Then, as the dissolved solution comes in contact with cooler rocks, “... metallic minerals precipitate to form veins or blanket-like ore bodies” (Kirkemo ..., 1997). A second hypothesis, typical especially in granitic rock suggests that the “...gold-bearing solutions may be expelled from magma as it cools, precipitating ore materials as they move into cooler surrounding rocks” (Ibid). A final hypothesis introduces a correlation between metamorphic processes and gold. Most common in mountain belts at continental margins, as sedimentary and volcanic rocks are subducted, the heat and pressure trigger chemical reactions that alter the mineral composition of the rock and release water. This water, less dense than the surrounding material, moves upward and precipitates the ore material (Ibid).

But which hypothesis has that “Cinderella-glass-slipper” fit? The Sierra Nevadas seem to meet the criteria of all three. After all, the Sierras are marked with volcanic activity that stimulates hydrothermal processes. The hot springs at Hot Creek are the Mono Craters created from phreatic explosions are evidence of that. Hypothesis #2 requires granite. Check. The Sierras are predominantly granite – a direct result of the weathering and erosion of the original Sierran Arc. Finally, the Sierras meet the demands of the third hypothesis: mountain belt at continent margin. As the Farallon plate subducted and the Pacific plate sheered against the North American Plate, the “match was made” for stretching and thinning and the emergence of the Basin and Range (Field Work, 2002).

“Curious. Very curious,” thinks a hypothetical minor reading the above mentioned research. “Strange that with such an emphasis on lode deposits, a vast majority of the gold I stumble across is in nuggets or flakes.” An astute observation – the type of observation that quickly captures an inquisitive reader’s attention and causes him or her to ponder both the physical location and chemical properties of gold. In fact, it is the unique chemical properties of gold that directly impact its physical location within the Sierras and other locations across the globe. “Gold was among the first metals to be mined because it commonly occurs in its native form, that is, not combined with other elements ...” (Kirkemo ..., 1997). In addition, gold is classified as a “noble” metal because it does not oxidize under regular circumstances (Ibid). These qualities make gold resistant to weathering.

Therefore, as the rocks encasing a lode (primary) deposit of gold become weathered or eroded away, gold retains its original chemical properties. The newly freed gold “...is carried downstream as metallic particles consisting of ‘dust,’ flakes, grains, or nuggets” (Ibid). According to Harvey Neese, author of Gold: Mining for Recreation, “The moving water causes the heavier gold particles to work slowly downstream until the gold lodges in crevices, cracks or other irregular openings in the streambed. Named placer (secondary) deposits, gold distributed as a result of erosion and weathering processes was the bait that lured the miners in ...

* Part II: Miners (The Blue Car) *

There was a grand dream – the backbone of American society. Something was different here – something in the air. Or at least in the hearts of the people. Yes, deep within the hearts of the American people there was a faint whisper. “You deserve the best. You can be the best.” After all, life was some sort of game and you won when you could take a step up the ladder. That’s why people came to America. In America, you could be anything you wanted to be. From across the globe the oppressed fled to a melting pot of opportunities – the opportunity for social mobility. Children were not held down by the class of their parents. No, in America, you, like Horatio Alger, could ascend from rags to riches.

There was a second grand dream in America – a dream of power. Historians affectionately call this dream “Manifest destiny”, and they define it as an inherent belief of the American people that their way of democratic life should extend from ocean to ocean – Atlantic to Pacific (Davidson...2001). It was this dream that guided the political philosophy of James K. Polk, who instigated a war with Mexico to gain the territory of California. It was this dream that would bring the glory of the red, white, and blue to the Pacific.

And it was a combination of both dreams: rags to riches and manifest destiny that would, in part, govern the development of the Great West. Two dreams, the political victory in the Mexican War, and (Oh Yeah!) a bit of gold that would transform the west from a barren, mountainous landscape into the home of the fastest growing population in the United States. Indeed, the spark that exploded into a mass influx of people into the Western United States was the discovery of gold by James Marshall at Fort Sutter on January 24, 1848 (Billington, 1956).

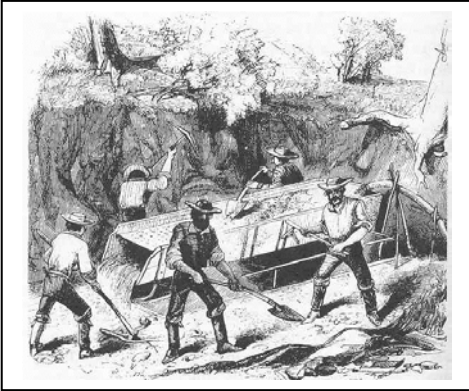
Though the California Gold Rush began as a local affair, by 1849 men (only approximately 5% of the 49ers were women and children) came from all ends of America and all corners of the globe to test their luck. “More than 80% of the prospectors who poured into the gold county were Americans, including free blacks. Mexicans, Australians, Hawaiians, Chinese, French, English, and Irish also came” (Davidson...2001). An 1850 census stated that 25% of California’s population was foreign born (Young, 1966). Over land and through the sea, they came.

Who could blame them? For the lucky, the rewards were handsome. Though those who struck fortune were few and far between, stories of their wealth were the bait that lured new 49ers in. A twenty-eight pound nugget surfaced in Sonora. Seven friends unearthed 273 pounds from the Feather River in just seven weeks (Lavender, 1965). On a daily average in 1849, a miner could make \$16. By 1852, it had fallen to \$6 (Billington, 1956). Still, this was significantly higher than wages back East. A good deal if the miner was willing to pay the high prices for supplies and face the risk of injury.

* Part III: Gold and Miner Collide *

The development of society in California was a collision between a dream and a reality. The dream was to get rich overnight. The reality was an uncompromising

geology. Simply, the supply of gold did not meet the demand of the money hungry miners: there was not enough gold readily accessible to go around. So, miners compromised. They learned that by working together, they could utilize more complicated mining techniques; and as a result, mining camps and, later, towns developed. Of course, the same spirit of Manifest Destiny that brought the 49ers to California dictated the development of mining camps and towns.



The process and development of mining camps and towns was a result of two key components: the geology of the gold and the application of human nature. The geology of the gold determined the stability and longevity of a camp or town. Different mining techniques necessary for placer vs. lode deposits determined whether a camp (temporary) vs. a town (more permanent) would develop. Human nature controlled the creation of the culture and value system for the community.

The different mining techniques used for placer deposits and lode deposits directly affected the type of community that developed. Why the difference? After all, gold is gold. True. But there is a world of difference between a gold pan and a stamp mill. Imagine Bob. Bob is a youthful, vivacious 49er in his twenties.



Our friend Bob
– ready to
mine.

Heading west from Independence, Missouri across the Santa Fe Trail to the Old Spanish Trail to the base of the Sierras, Bob survives the rugged journey by eating pork and beans and sticking with a group of other young optimists. Finally, he arrives. And the celebration begins – with his gold pan in hand. His work will be characterized by the same processes as other early arrivals. His work will be in streams and rivers or dry gravel rumored to contain gold. His is the work of miners fortunate to taste the sweet victory of the placer deposits.

Remember the placer deposits? Because gold is a heavy noble metal resistant to most weathering and erosion, it retains its chemical properties even when the rocks around it eroded away. Not a bad deal. Not only does the gold maintain its properties, but it also gets to go on a joy ride. Expelled from the “prison” of the rock, gold often is carried off by water or glaciers and deposited in rivers. Often, the gold will settle or nestle in cracks in meandering streams. Therefore, an ambitious and patient miner such as our buddy Bob can use a simple device, a gold pan, to sift through river waters; and most likely, he will be able to cash in on the convenience. First, Bob will fill his pan with sand or gravel and a thin layer of water. Next, he will break down the larger rocks by kneading with his hands. With an oscillating motion, Bob will then be able to expedite the process that gravity does over time: the heavier objects will settle along the bottom of the pan. Slowly eliminating the rock from the minerals, at the end of a twenty minute process, Bob will hopefully see that reassuring sparkle that made the trip west worth the risk – GOLD (Nesse, 1981)!

“In 1848 and early 1849 unprospected streams were so numerous and yields so high that miners could afford to employ individualistic techniques usual in frontier communities ... With the flood of newcomers these techniques no longer sufficed” (Billington 1956). New methods for mining were developed. “River Companies” built dams in at the base. After weeks of work, if they were lucky, the miners could rush out with gold pans in hand and enjoy the fruit of their labor. Another technique developed was called “coyoting”. Miners would dig tunnels upon tunnels to reach the collection of gold dust. With both the dams and tunnels, gravel still needed to be sorted away, so the miners employed “sluice boxes” pictured above – (basically huge gold pans manned by multiple people (also called cradles) (Ibid).

With teamwork guiding the work in the fields, it was inevitable that the same teamwork would follow the 49ers home – to the mining camps. Mining camps became the social unit of the gold rush. Everything about the camps encompassed the attitude of the 49ers. Guided by the American dream of social mobility and the ability to advance one’s position in life, the mining camps exploded with the crazed, hurried passionate cry of “Boom or bust!” Camps sprung up overnight along riverbeds and ravines. “Miners preferred to set up their tents or build their rough log or bark cabins on hillsides or in small flat areas close to their work sites” (Sherrow, 1998).

The rushed creation of the mining camps reflected the underlying principal that unit was a temporary institution – only useful and necessary when placer deposits of gold were still available. The temporary nature of the camps was expressed in every aspect of life. For example, in many of the camps some form of self-government developed, but the governments only outlined rudimentary procedures essential to maintain order. Most governing bodies developed laws in only two basic areas: procedures for establishing and maintaining claims and procedures for enforcing justice. Usually, the second consisted only of a sole “keeper of the peace”, the alcalde or sheriff, a judge, and a method for creating a jury (Billington, 1956). Without other permanent laws to establish order and set a framework for future development, the culture in the camps followed the fast-paced attitudes of the miners.

Bluntly stated, the culture in the mining camps was lustful. The miners were lustful for gold. The miners were lustful for pleasure. They wanted their piece of the “American dream”, and BY GOD, they deserved it. They had risked everything to come west. They worked hard - often without reward. Certainly, they deserved to immerse themselves in pleasure at the end of a long day. Or they at least deserved to try and drown out the failure and loneliness of the mining life with alcohol, gambling, and sex (20% of the women in California were prostitutes (Davidson...2001)) (Billington, 1956). “This lack of restraint meant that both the bad and good features of civilization would be sloughed away” (Billington, 1956) so that people from all walks of previous lives coexisted in a society that faded away as quickly as it had exploded.

“‘The whole country,’ wrote one San Francisco newspaper editor, ‘...resounds with the sordid cry of “gold! GOLD! GOLD!” while the field is left half planted, the house half build, and everything neglected but the manufacture of shovels and pick axes”’ (Lavender, 1965). As one mining camp was abandoned for a new, better location, the culture of mining camps rippled through California like sunlight dancing on water. Only sometimes – just sometimes – a specific location offered a prize more alluring than its neighbors. Something – with a scent of success strong enough to move corporate

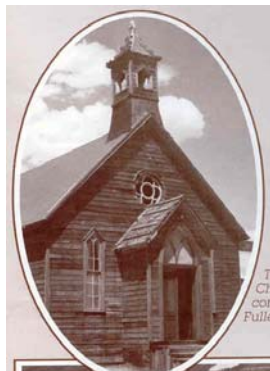
America in next door to the hardworking, hopeful 49ers – was out there. What was this mysterious prize? And more importantly, did it have geological roots!

Surprise! The final piece of the puzzle is the original piece ... lode deposits. The primary deposits of gold formed millions of years ago transformed the society of California from the temporary mining camps to the more permanent mining camps. Because the lode deposits of gold were embedded in the granite of the Sierra Nevadas, a more complex process was necessary to remove the ore. No longer could individual or small teams of miners afford the costs of mining lode deposits.

Welcome to America – where anyone can taste the dream. Anyone can transform from rags to riches. Anyone can succeed. Yes, anyone – any Joe or Bob off the street can strike rich. Anyone could. But few did. And as the “starving artists” worked diligently at their trades, the new guy moved in next door. (You know the one. You hate him because he takes your spot on the basketball team and gets the girl.) And he brought with him the secret formula for power in America. He brought corporations.

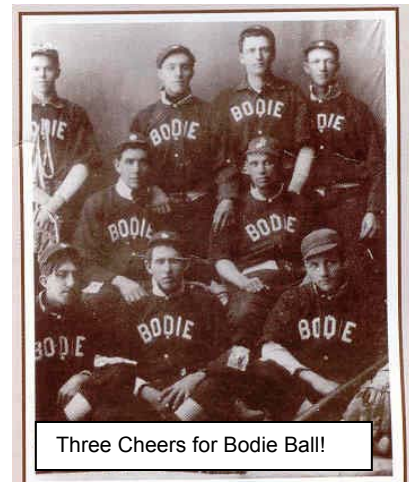
In 1851, according to the editor of the Alta Californian, the techniques of the individual miner were replaced with science and profession. Better technology improved upon placer mining techniques. Even bigger, technology introduced stamp mining, shifting the industry towards the lode deposits embedded in quartz. “Quartz mining became the rage in the fall of 1851, with crushing mills sprouting like mushrooms throughout the Mother Lode country ... With these changes mining passed from the hands of the 49ers into those of capitalists whose plush offices were in far away San Francisco and New York” (Billington, 1956).

The stamp mills transformed the gold industry in California. The miner who arrived with gold pan and high spirits in the rush of '49 now could trade in the adventure and the uncertainties for greater stability. Though placer miners still milked the riverbeds for one last flake or nugget, corporate owned stamp mines became the trend – a trend with staying power. Basically, the stamp mines operated much like an assembly line in a factory. Everyone had a part in the monotonous process. Step 1: Rock and quartz thought to house lode deposits were mined from the earth. Step 2: Large pieces were broke into smaller pieces, and sent to the next station. Step 3: Large “stamps” pounded the rock or quartz into fine gravel. Step 4: Similar to the gold pan technique, with the aid of Mercury, the mixture was separated into layers. Ideally, the heavy gold would sink to the bottom. But just in case ... Step 5: cyanide would separate any remaining “unruly” particles (Shipley, 2002).



Methodist Church in Bodie State Park

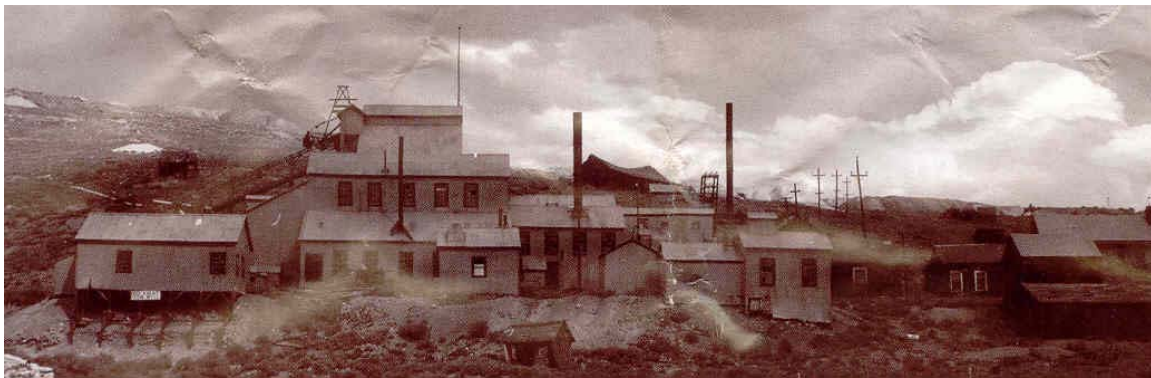
And around the mills, mining towns sprouted like leaves in the spring. Initially, the mining towns had that same “adorable” cultural flair as their shabbier mining camp counterparts. When touring Bodie State Park, a ghost town abandoned in 1942, for instance, my eyes widened as Jack Shipley, a retired Historian from the State Park, fondly directed our eyes towards the red light district. According to the brochure from the Park, “By 1879, Bodie boasted a population of about ten thousand and was second in the state for saloons, badmen and ‘the worst climate of doors’”(Bodie,



Bodie Baseball Team.

2001). I peered into the remains of the jail and walked past all that was lingering of numerous saloons.

At one point, Bodie's male to female ratio was 10:1. However, with time both the gender ratio and risqué culture mellowed out. With time, Bodie became a place for families and multiple industries. "As time went on, more women and children arrived. With them came more of the institutions and civilities that were typical of stable communities in the eastern states" (Sherrow, 1998). With hotels, stores, a post office, a baseball team, and a Protestant Church erected near Main Street, Bodie developed a distinct community unique from the transitory lifestyles in mining camps (Bodie, 2001). Though the herds poured into Bodie and the rest of the West (San Francisco is perhaps the most noted of the Boom Towns) with whisper of gold, they settled with the security of the stamp mills.



The Standard Mill was established in Bodie in 1861 bringing in money and people.

So life for the miners was grand (apart from the 40% risk of debilitating injury from working the mills (Shiple, 2002)). They came. They saw. They conquered. Or at least they settled. After all, they had had a dream. And they won. They had tamed the beast of the West. (Or they were tamed and domesticated by the "beast of the geology"). Regardless, they had fulfilled the prophecy: Manifest Destiny. The American flag now flew from coast to coast, and the remnant of the American Dream still hung in the air – forever blowing in the breeze above the corporate-owned mills.

* * *

It really is a long story. Maybe even three long stories. First there was gold. Then there were people. And in January of 1848, one man changed it all when he found the gold that triggered the people. Kind of like merging on the expressway. But only kind of. Really, it's more of a question. It sparks a thought process. What was the catalyst that shaped the mining camps and towns: the dream (a dream of success) or the reality (an uncompromising geology)? People mined the gold. People changed the face of California. Right? Or did the geology of the gold change the face of the people? After all, different lifestyles did spring from different mining techniques. It reminds me of a song – a one hit wonder by Semi-Sonic. "Closing time. Every new beginning comes from some other beginnings end." Things are kind of like that in California. Kind of.

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Works Cited

- Billington, Ray Allen. The Far Western Frontier: 1830-1860. New York: Harper Torchbooks, 1956.
- “Bodie State Historic Park”. Pamphlet. Sacramento, California: The Friends of Bodie, 2001.
- Davidson, James West and William E. Gienapp, Christine Leigh Heyrman, Mark H. Lytle and Michael B. Stoff. Nation of Nations: A Narrative History of the American Republic. Boston: McGraw Hill, 2001.
- Hill, Mary. Geology of the Sierra Nevada. Berkeley: University of California Press, 1975.
- Kirkemo, Harold and William L. Newman and Roger P. Ashley. “Gold”. U.S. Geological Survey. <<<http://pubs.usgs.gov/gip/prospect1/goldgip.html>>> 1997.
- Lavender, David. The American Heritage History of The Great West. New York: American Heritage Publishing Co, Inc., 1965.
- Nesse, Harvey. Gold: Mining for Recreation. San Francisco: Chronicle Books, 1981.
- Sherrow, Victoria. Life During the Gold Rush. San Diego, California: Lucent Books, 1998.
- Shiple, Jack. Interview. Historian for California State Parks. May 30, 2002.
- Young, Bob and Jan. The 49'ers: The Story of the California Gold Rush. New York, Julian Messner, 1966.
- Field Work from Sierra Nevadas. Compiled by Laura Dunn. May 18-June 1, 2002.