

# Sovereign Hill Education

## Mining Technology

### Research Notes for Secondary Schools



Gold was first discovered in Ballarat in August, 1851. There were three main methods of mining used on the Ballarat field:

**Surface Alluvial Mining, Deep Lead Mining and Reef (Quartz) Mining.**

Most gold on Ballarat was won from deep lead mining.

#### 1. Surface Alluvial Mining

Over time, weathering breaks quartz rocks down into sands and gravel, freeing any trapped gold. This gold, which is called alluvial gold, remains close to the surface where it may be washed down and deposited in nearby streams. As gold is six times heavier than most gravel and stones, it rapidly sinks to the bottom of any stream.

#### 2 Deep Lead Mining

Sometimes, gold deposited in creek beds was covered by lava from nearby volcanoes. This lava hardened into basalt and deep lead mining involved digging through these layers of basalt to reach the gold buried in old creek beds.

#### 3 Reef (Quartz) Mining

This involved digging to find the gold bearing quartz reefs, which had been formed long ago in the cracks and crevices caused by earth movements.

#### Methods of Alluvial and Deep Lead Mining

##### Alluvial Mining

Alluvial gold created the gold rushes. Any man in good health could take his chance at finding a fortune. All he needed was a pick, a shovel, a goldpanning dish, a tent,

some bedding and a few cooking utensils. This method relied upon the fact that gold was heavier than the sand, gravel and clay (washdirt) and so sank to the bottom of the creeks. A miner would separate the gold from the washdirt using a **pan, cradle** or **sluice box**. In the early days, before creeks were “panned out”, the miners would simply proceed up a creek, washing shovelfuls of clay and gravel taken directly from the banks or bed of the creek.

Although this gravel contained some gold, the really rich washdirt was to be found in the old creek beds that had been covered by basalt from volcanoes. To reach these, the miners often had to sink shafts through the **overburden** using a **windlass**, or in the case of deeper mines, a **whim** or a **horse-drawn whip**.

#### Methods of Washing the Gold

##### Panning

A shovelful of sand, gravel and clay from the creek bed was placed in a pan. The prospector then **puddled** the mixture. This means he placed the pan in flowing water, broke up the clay with his hands and mixed it with the water so that the water washed the clay away. Any large stones would then be removed. Shaking the pan well to cause gold particles to sink to the bottom of the pan, the prospector would tilt it, and with a circular backward and forward motion, swirl the water in the pan, allowing a little gravel to be washed over the lip of the pan into the creek. When the last of the sand had been gently washed off, any gold in the washdirt was left in the pan. The prospector would then sharply swirl the remaining

water to spread out any specks of gold over the bottom of the pan.

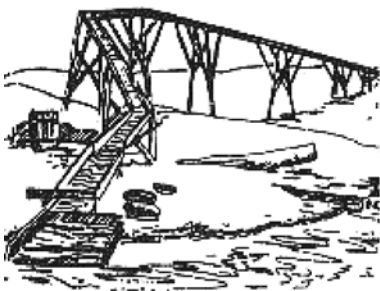
### **Cradling**

Panning was slow, back-breaking work, so the next development was the cradle. The cradle consisted of a box, fitted on rockers, so that the operator rocked it to and fro. Inside the cradle were two sloping shelves with thin strips of wood fastened across them. These were called **riffles**. On the top of the box part of the cradle was a sieve made of metal plate with holes punched in it. Often, two men worked the cradle, one shovelling the washdirt onto the sieve and the other working the cradle with one hand and using a **dipper** with the other to take water from the creek and pour it over the washdirt as the cradle was rocked. The sieve prevented any large pieces of stone going into the box. These pieces were checked at intervals to be sure none were nuggets. Then the sieve was emptied. The gold-bearing gravel passing through the sieve was washed down through the shelves and any gold present was caught in the riffles, while the gravel was carried through a chute back into the creek. Often blanket, felt or corduroy was fitted to the floor of the chute to catch any fine gold dust missed by the riffles.

*To see a photograph of "Panning off with dish, tub and cradle" visit the Students section visit the Students section of the Sovereign Hill Education website.*

### **Sluicing**

If running water was available, then even more dirt could be processed through a **sluice** or "**long tom**". The idea was exactly the same as in cradling, but the running water broke up the pay dirt, and washed away the lighter sands and gravel, leaving the gold caught in the riffles of the sluice box.



*A long tom at the end of a flume*



*A windlass*

### **Deep Lead Mining Shallow mines**

#### **The windlass**

These were used in shallow shafts to lift dirt to the surface. They required very little skill to build, were made from simple materials and could be easily moved.

In the beginning, the **windlass** frame would be flat on the ground. Waste material (**mullock**), brought up to the surface in the bucket, would be tipped in a pile around the shaft. As the mullock grew higher, a "pig sty" of logs would be built around the shaft and the windlass moved upwards. Thus, the windlass was soon on a hill created by mining. The windlass was only effective to a depth of approximately 40 metres. It was too slow, and the work too hard to use on deeper shafts.

Successful miners who had sunk shafts on good, paying washdirt were able to spend some time making their working conditions a little more comfortable by building a shelter over their shaft. This meant that the man operating the windlass, and the miner down in the shaft, filling the buckets for the other to wind up, were not as exposed to the weather.

Over the shelter, a **windsail** would often be erected to ventilate the shaft. This was necessary because when a shaft was 15 – 20 feet (5 - 7 metres) deep or more, there was not enough natural air flow to provide fresh air and the shaft became stuffy and uncomfortable.

In some of the old creek beds, the air was fouled from rotting vegetation. The windsail operated by being turned to face the wind, thus funnelling the air into the canvas tube which carried it down to the bottom of the shaft.

## Deeper Mines

### The Whip

Only a miner, or group of miners who were wealthier than most, could afford to use a **whip** because of the cost of the horse. Horses were both expensive to buy and feed. A whip meant that a mine could be 80 metres or more in depth. The horse was walked out along a straight walkway. When the bucket reached the surface, the rope was unhooked from the harness, the horse turned around, rope hooked onto the front harness, and the horse walked back down the whip path. The horse did not walk backwards.

One of the earliest of these was the **hand whip** or "**chinese whip**". A long pole was centrally pivoted on a forked stick firmly set in the ground. As the miner pulled on a rope attached to one end of the pole, the bucket was raised out of the shaft.



A Whim

### The Whim

For still deeper shafts, the **Whim** was used. These were expensive. A whim consisted of a large drum with a few turns of cable wound on it. Both ends of the cable were left free to run over pulleys down the shaft. A bucket (kibble) was attached to each end of the cable. As the horse walked around, the drum revolved and one bucket would be lowered down the shaft as the other was raised. A special harness was used which enabled the horse to turn around and walk in the opposite direction in order to reverse the movement of the buckets.

### Puddling Machine

As the miners dug, every bucketful of dirt removed would have to be washed and checked for gold. The stiff, yellow clay was very difficult to break up, so a **puddling machine** was often used to break up the washdirt and allow the gold to sink. Water and washdirt

were added to a circular trough and the mixture stirred by a horse pulling a rake. The water became a soupy sludge, which allowed the heavy gold particles to sink to the bottom. The water was then drained off, and the layer of stones and gold left in the bottom of the trough was then panned, cradled or sluiced to recover the gold. Usually, one man on a goldfield would own and operate the puddling machine and miners would bring their dirt to the machine and pay the owner to put it through the puddling machine.

*To see a photo of a horse-drawn puddling machine visit the Students section of the Sovereign Hill Education website.*

### Chilean Mill

Besides finding some fine gold and nuggets in these mines, miners also found lumps of quartz and rocks. The quartz had to be crushed to extract the gold and this was often done with a **chilean mill**. The mill wheel was pulled around by a horse to crush the quartz rock. The crushed rocks were then panned or cradled to separate the gold from the fine crushed rock.

By the 1870s, much of the alluvial and deep lead gold had been mined out. Huge amounts of capital were required to mine the reef and deep lead deposits and thus, company mines appeared on the Ballarat field.

*To see photographs of Peakes Battery at Golden Point in 1858, the Britannia Mine in 1889, the North Woah Hawp Mine in 1894, the Sir William Don Mine visit the Students section of the Sovereign Hill Education website.*

